JUN 7 1935

CIVIL ENGINEERING

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LAKE AMONG SIERRA NEVADA PEAKS
Remnants of Winter Snows Contribute to Stream Flow During the Rainless Summer

Volume 5 — Number 6 —

JUNE 1935

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Among Our Writers

W. D. STYER, after graduating from West Point and Massachusetts Institute of Technology, served with the U. S. Engineer Corps in many different kinds of engineering work, including road construction, marine design, river and harbor maintenance and betterments, and construction of war memorials in Europe. With the rank of major, he is now U. S. district engineer in charge of river and harbor improvements in the Pittsburgh district, comprising the upper Ohio valley drainage basin.

FRANK E. BONNER has been in the engineering service of the federal government in one capacity or another for almost 25 years. At various times he was connected with the Forest Service, the Federal Power Commission, and the Bureau of Reclamation. During the past four years Mr. Bonner has been in private practice in California, his activities being related chiefly to water supply projects in that state.

ROBINS FLEMING has had a long career in structural steel design, and can speak with authority on questions of stresses in tall buildings. Since his retirement in 1931 he has interested himself particularly in the history of skyscraper development. Mr. Fleming is the author of a number of articles on structural engineering.

WALKER R. YOUNG had charge of canal and dam construction work for a number of years before he was appointed construction engineer for the Boulder Canyon project. Other details of his experience appeared in "Among Our Writers" for the May issue of CIVIL ENGINEERING.

CARL E. BENTZEL has a degree in mechanical engineering from the Chalmers Institute of Technology, Gothenburg, Sweden, 1922. He was engaged for seven years by Allied Engineers Inc., of Birmingham, Ala., and for three years with the U. S. Waterways Experiment Station at Vicksburg, Miss. During the latter engagement he designed the tilting flume which is described in this issue, as well as a velocity tube. Mr. Bentzel is now assistant hydraulic engineer with the Tennessee Valley Authority.

JOSEPH B. TIFFANY, JR., after graduating from the University of Illinois with a bachelor's degree in civil engineering, joined the staff of the U. S. Engineer Office at Cape Girardeau, Mo. In April 1933 he was transferred to the U. S. Waterways Experiment Station at Vicksburg, Miss., where he later became head of the general research group, retaining his position as editor of the station's reports. Mr. Tiffany is also in charge of the "directive energy" laboratory model of a spillway, in which general laws of river flow are being studied.

ALBERT A. MITTAG graduated from the Cooper Union Institute of Technology in 1925 with the degree of bachelor of science in civil engineering and received his C.E. from the same institution in 1932. After an engagement in Salvador and Colombia on highway location and construction, he served from 1930 to 1933, successively, as engineer, assistant chief engineer, and chief engineer with the constructing quartermaster at Albrook Field, Canal Zone, and at Langley Field, Va. Mr. Mittag is now engineer in charge of construction, Pan-American Airways, Inc., stationed at the Island of Midway in the Pacific.

VOLUME 5 NUMBER 6

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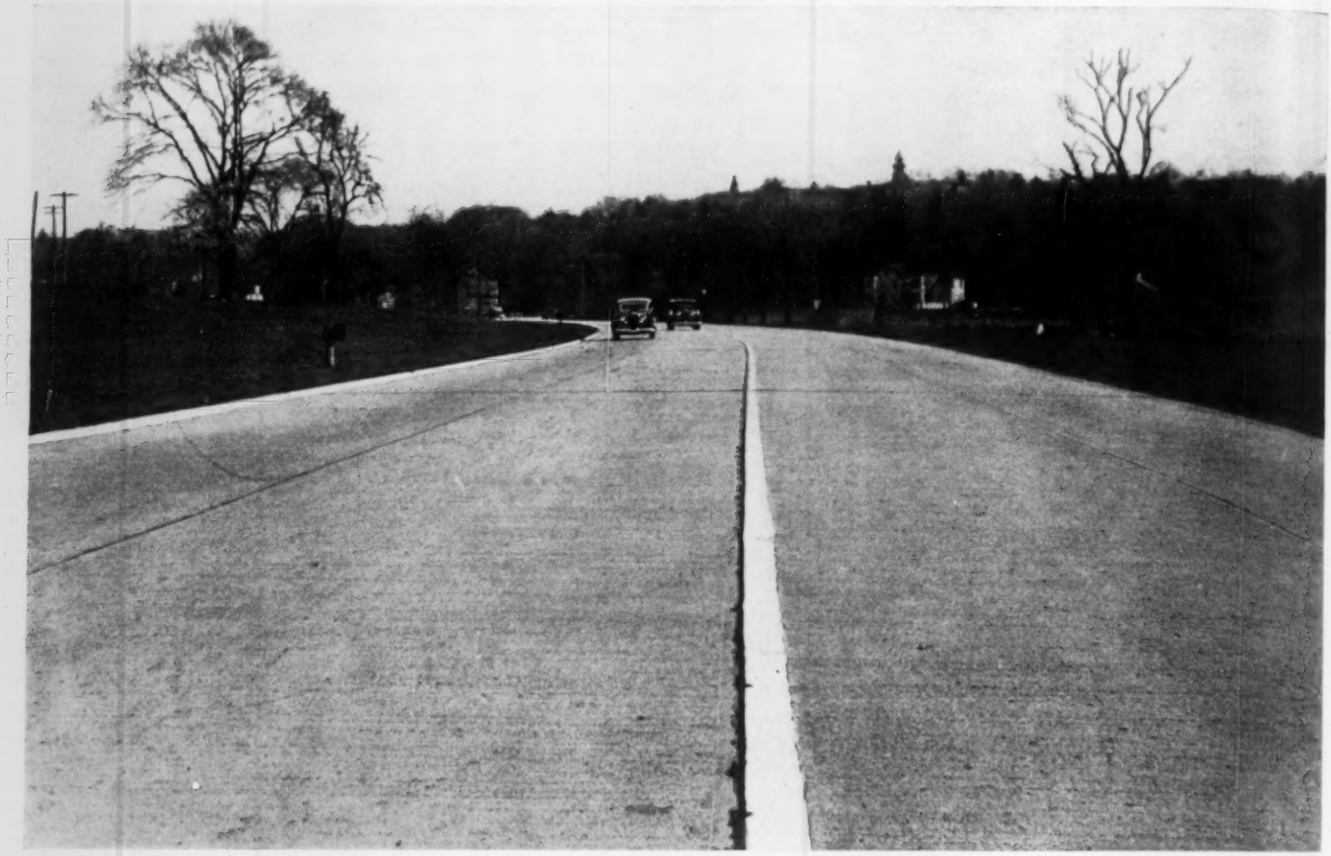

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JUNE 1935

VOLUME 5

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NUMBER 6

The Tygart River Reservoir Project

Work Progresses on a Unit of the Source-Control Program to Regulate Floods on the Upper Ohio

By W. D. STYER
MAJOR, CORPS OF ENGINEERS, U. S. ARMY; U. S. DISTRICT ENGINEER, PITTSBURGH, PA.

REGULATION for flood control and for slack-water navigation frequently involves a conflict of purposes. But in the case of the Tygart River Dam in West Virginia, both of these aims can be furthered. It is expected that local rainfall and run-off conditions will make it possible, through the utilization of the 327,500 acre-ft storage, not only to ameliorate floods on the Ohio and prevent floods on the Monongahela, but also to improve navigation on the latter stream. Additional benefits anticipated are the improvement of water supplies through neutralization of acid wastes and dilution of sewage, together with some power development. Construction work on the dam began in December 1934, and has already proved of great value in relieving unemployment and stimulating industry in a territory hard hit by the depression. This article by Major Styer, District Engineer in charge of the work, presents the considerations involved in constructing one of the highest dams in the eastern part of the country.

CONSTRUCTION of a high dam near Grafton, W.Va., to form a reservoir in the Tygart River valley, has been begun by the Corps of Engineers, U. S. Army. This reservoir will form one of the units of the comprehensive flood-control project of the Army engineers for the source control of floods in the upper Ohio River basin, studied under authorization of House Document No. 308, 69th Congress, 1st Session. The Tygart River Dam was adopted as Federal Public Works Project No. 44 by the Federal Emergency Administration of Public Works.

The Tygart River basin, in northern West Virginia, is of a rugged character, lying between the rolling Allegheny plateaus on the west and the Cheat Mountains on the east. It appears that the Allegheny series of coal veins extends practically throughout the basin except in the valley of the Tygart River south of Elkins, W.Va., and in the valley of the right headwater of the Buckhannon River. The Pittsburgh coal bed of the Monongahela series of coal veins appears in limited areas and at a considerable elevation in the vicinity of the mouth of the Tygart River and its minor western tributaries bordering the adjacent West Fork River basin.

For about 131 miles the Tygart River retains its designation—from its extreme source in Pocahontas County, West Virginia, to its junction with the West Fork River at Fairmont, W.Va., where it forms the head of the Monongahela River, as shown in Fig. 1. The Tygart is a mountain stream which winds considerably through its basin and has two principal tributaries, the Buckhannon and Middle Fork rivers. Its average slope is about 12.6 ft per mile. Between its mouth and Valley Falls, below Grafton, the slope is relatively steep, about 16.6 ft per mile. Between Valley Falls and the mouth of Sandy Creek, above Grafton, it is relatively flat. Again, in the vicinity of Philippi and near and above Elkins the slope is about 3.8 ft per mile, in contrast with the maximum of about 34.3 ft per mile, which obtains near the mouth of the Middle Fork River.

The maximum stream flow of record for the Tygart River, occurring on July 25, 1912, amounted to 57,600 cu ft per sec, and the minimum, which occurred on

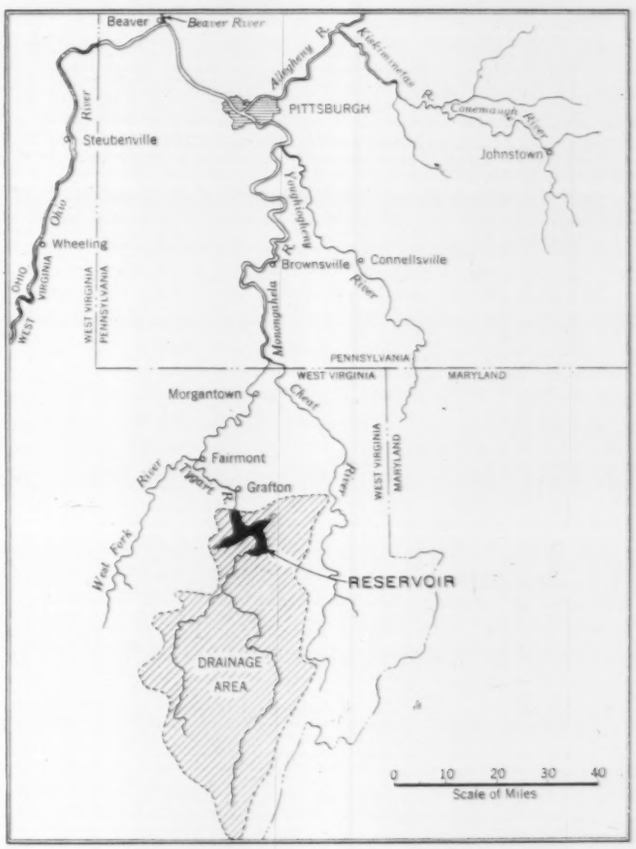


FIG. 1. GENERAL LOCATION OF TYGART RIVER RESERVOIR

October 21, 1930, amounted to only 1.1 cu ft per sec. The mean stream flow is about 2,586 cu ft per sec. These data are taken from the records of the Tygart River gaging station at Fetterman, W.Va., immediately below Grafton, and cover a period of over 26 years, from June 3, 1907, through 1934. The tributary drainage area above the gaging station is 1,340 sq miles.

ONE OF THE HIGHEST DAMS IN THE EAST

The dam that will create the Tygart Reservoir is located on the Tygart River in Taylor County at a point 2.25 miles upstream from Grafton, W.Va., immediately above the water works of that city. The elevation of the river bed at the site is about 960 ft above mean sea level. Plans provide for a spillway elevation of 1,167. Thus the spillway structure will rise about 207 ft above the river bed. From the foundation to the top of the non-overflow sections the maximum height of the dam will be approximately 240 ft, and its length at elevation 1,190 will be about 1,850 ft between contours. Plans provide for a concrete gravity dam, together with an adequate spillway, regulating works, cushion pool for the dissipation of kinetic energy below the dam, gaging station, dam appurtenances, and operators' quarters.

GENERAL VIEW OF TYGART RIVER VALLEY, LOOKING UPSTREAM FROM JUST BELOW THE DAM SITE

Foundation investigations at the dam site, conducted under the supervision of expert consultants, included studies of all the available geological data of the region; a comprehensive and detailed subsurface investigation by means of core borings, using both vertical and inclined holes; excavation of extensive exploration trenches; and chemical and physical tests of the materials encountered. Further investigations to be made as the excavation progresses will include the taking of additional cores 30 in. in diameter, the holes forming inspection shafts for detailed examination of the foundation material.

Foundation rocks consist of a series of alternating sandstone and shale strata, both satisfactory in their natural condition, before surface weathering, from the standpoint of bearing strength and slight permeability. The shale is of excellent quality, is thoroughly lithified, and will be unaffected by ground water. The lower part of the foundation will rest on firm sandstone or unaltered shale. The spillway section will be founded on a thick sandstone horizon underlain by firm, compact shale, and from this section the foundations will be stepped up the hillsides to the abutments. All weathered material will be removed and excavation continued until unaltered shale or sandstone of satisfactory quality is reached. On each section the shale will be excavated just before the concrete is poured and will be further protected from weathering or disintegration by protective coatings where necessary. The foundations will be pressure-grouted to ensure impermeability of the strata underneath the dam.

The dam will be constructed of concrete, made, placed, and cured in accordance with the specifications of the U. S. Engineer Department for this class of structure. About 1,200,000 cu yd of concrete will be required. It will be deposited in approximately parallel layers about 18 in. thick on a grade of about 10 per cent, sloping up from upstream to downstream, and will be vibrated by both internal and external means. Construction joints will not be grouted, but water stops will be provided for vertical construction joints and for horizontal joints between pours. Portland cement, modified to reduce the heat generated in the mass, will be used.

Crest gates will not be provided in the spillway section. The regulating works will consist of eight pairs of slide valves and two large needle valves, the latter to regulate the water supply for navigation. The slide valves are each 5 ft 8 in. by 10 ft, and the pairs are arranged in tandem. A stilling basin, or cushion pool, for dissipating the kinetic energy of the water flowing over the spillway or through the regulating outlets will be formed by a low dam several hundred feet downstream from the crest of the main dam. Model tests have been employed to check and determine the form and arrangement of this part of the work as well as to obtain hydraulic data concerning other features of the dam.

AREA AND CAPACITY OF RESERVOIR

At elevation 1,167 the reservoir will extend for a distance of over 11 miles up the valley of the Tygart to the vicinity of Moatsville, W.Va., and also up Pleasant Creek valley for about 5 miles. This latter, a flat valley typical of many in the basin, will form the western arm of the reservoir. At the highest contemplated water level, elevation 1,167, the reservoir will have a capacity of about 327,500 acre-ft, a surface area of about 3,860 acres, and a shore line of about 70 miles. At elevation 1,090, the maximum level of storage for navigation purposes, the capacity will be about 100,000 acre-ft; the surface area, about 1,780 acres; and the shore line, about 33 miles. Somewhat more than a third of the reservoir area is in timber and brush.

The Tygart Valley itself is not densely populated. The reservoir proper lies partly in Taylor County and partly in Barbour County, West Virginia. According to the 1930 census, the population of Taylor County is 19,114, and that of Barbour County, 18,628. The principal cities in the valley, near the reservoir but outside the flooded area, are Grafton, W.Va., with a reported population in 1930 of 7,737, about 2¼ miles below the proposed dam, and Philippi, W.Va., with a population in 1930 of 1,767, situated some 10 miles by river above the head of the reservoir. Within the area to be flooded there are no towns or cities. Only a few scattered farm houses and a small number of unincorporated settlements will be affected. Among the latter are Yates,

with a population of about 50; Stonehouse, about 15; Cecil, about 25; Cove Run Station, about 10; Moatsville Station, about 35; and Pleasant Creek, about 20.

The population of the area to be flooded is mostly engaged in minor agricultural pursuits. No important industries will be affected. Although the reservoir site is underlain with coal veins, they apparently have little present economic value, since they lie relatively deep in the lower end of the reservoir site and are not now being mined. The Grafton–Belington branch of the Baltimore and Ohio Railroad, running through the valley at a low level along the right bank of the river, will have to be relocated. In addition, about one mile of primary highway in Pleasant Valley between Grafton and Philippi will be affected, as well as a relatively small mileage of secondary highway.

BOTH FLOOD CONTROL AND SLACK-WATER NAVIGATION PROVIDED

Flood control and improvement of navigation are the two primary purposes of the Tygart River project. However, the benefits will also extend to domestic and industrial water supplies, sanitation, and in some measure to power development along the Monongahela and upper Ohio rivers.

In general, the contemplated plan of operation of the Tygart project is as follows. At the first of each calendar year, the reservoir will be practically empty. It will then be operated solely for flood-control purposes by retention individually of all flood flows when the Pittsburgh gage indicates the approach of a flood stage, and by the prompt release of impounded water from the reservoir when the Monongahela River at Pittsburgh is below the flood stage. Beginning about April 1 and continuing until about July 1, a volume of 100,000 acre-ft of water will be allowed to accumulate in the reservoir. From then until about December 15, this volume will be drawn on as required to maintain a regulated discharge of about 340 cu ft per sec at Lock No. 8 on the Monongahela River, or when not so required will be gradually released so as to benefit navigation by increasing the navigable depth. From about December 15 to the end of the year, the reservoir will be empty, or practically so.

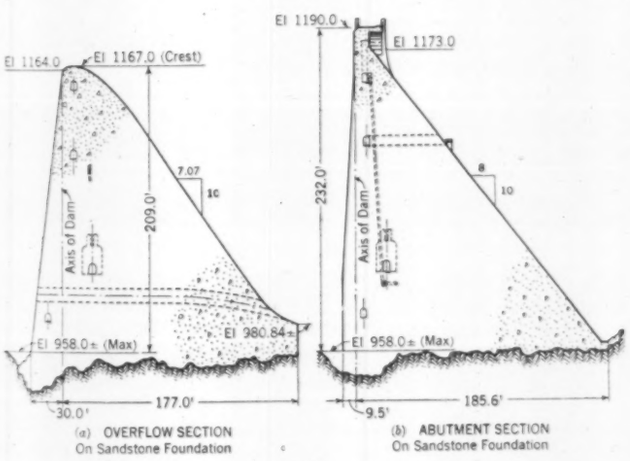
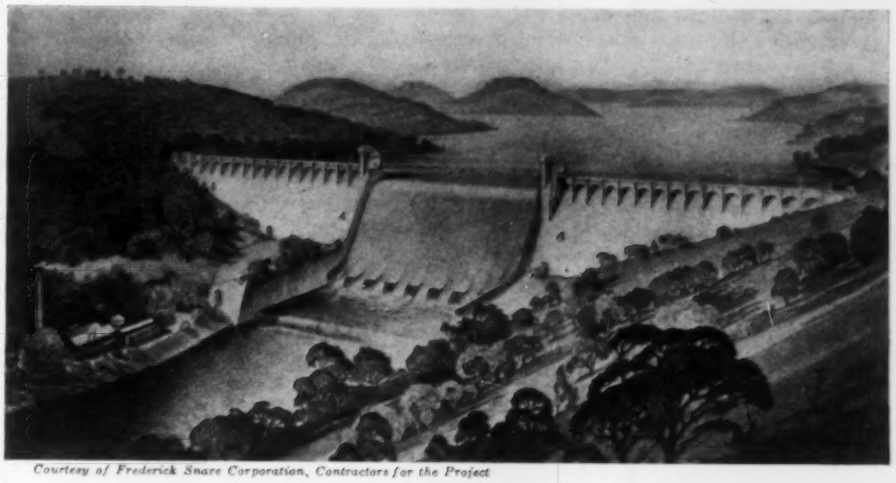


FIG. 2. SECTIONS ON SANDSTONE, TYGART RIVER DAM

This plan of operation is necessary in order that the reservoir may attain its maximum utility for flood control and navigation. Actual operation will differ in various years, depending to a large extent upon the amount and distribution of the runoff. In a year of severe drought, practically the entire storage for navigation purposes will be utilized between July 1 and December 15. At all times a discharge will be allowed from the reservoir equivalent to at least the low-water requirements of the riparian interests. It is estimated that the reservoir will thus be able to supply the water required for navigation on the Monongahela River. Not only will it assure an adequate supply for the locks and dams, but also it will generally provide a surplus. As the storage will be replenished annually, it can be drawn out annually, whether fully required or not. This additional sustained discharge will serve to increase the depth in the pools, with consequent benefit to navigation.



Courtesy of Frederick Snare Corporation, Contractors for the Project

ARTIST'S CONCEPTION OF THE TYGART RIVER RESERVOIR DAM

VALUE OF PROJECT IN RELIEVING UNEMPLOYMENT

As one of the public works projects authorized under the National Industrial Recovery Act, the Tygart River project has considerable value as a means of relieving unemployment and stimulating industry. The residents of the area have been suffering for several years from the effects of present economic conditions, and the consequent great amount of unemployment and industrial depression.

Clearing of the reservoir area was started about a year ago and has been practically completed. The contract for the construction of the dam was awarded to the Frederick Snare Corporation, with main offices at 114 Liberty Street, New York, N.Y. Actual construction by the contractor started about December 31, 1934. The approximate number of men to be employed on the work is shown in the following list:

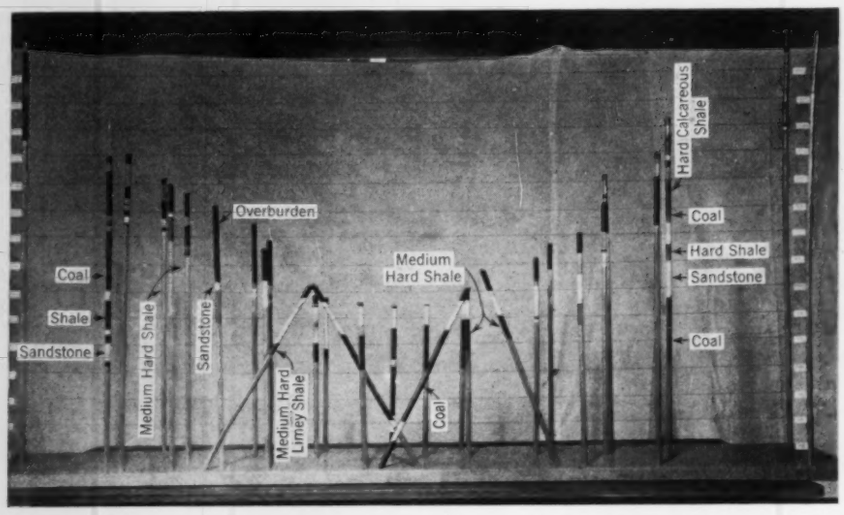
MONTH OF CONSTRUCTION	NUMBER OF MEN
First	300
Second	900
Third	1,800
Fourth to thirty-third	2,200
Thirty-fourth	1,800
Thirty-fifth	900
Thirty-sixth	300

Of the total cost of the project, estimated at $15,700,000, about $7,000,000 will be expended for labor and about $4,000,000 for construction materials. The

remainder will be used for such items as land, buildings, resources, and flowage. The annual maintenance and operating expense is estimated at about $45,000.

UNUSUAL FLOODS AND DROUGHTS OF RECORD

Many will vividly recall the great flood of 1907 and that of 1913 in the upper Ohio basin. The more recent high water of the spring of 1933, with its potentialities for disaster, is still fresh in mind. The Monongahela valley suffered a great flood in 1888, but fortunately for the Pittsburgh area, its effect was confined to the Monongahela basin. Since 1854, when continuous records were started, Pittsburgh has experienced 86 periods of high water above the flood stage, or an average of 1.07 floods per year. An analysis of the floods of record throughout the Monongahela valley indicates that the Tygart River is a contributing factor. It is expected that this project will eliminate floods from the lower Tygart valley and alleviate flood conditions in the entire reach of the Monongahela valley.



PEG MODEL OF CORE BORINGS USED IN STUDYING FOUNDATION CONDITIONS

In the summer and fall the Monongahela presents the other extreme. The dense and rugged strata which abound in the basin retain but a relatively small part of the precipitation, so that the discharge of the streams is poorly sustained during severe droughts. During the unprecedented drought of 1930, which lasted practically from the early part of July to the middle of December, navigation was suspended entirely on the upper Monongahela above the mouth of the Cheat River, or throughout navigation pools Nos. 8 to 15, inclusive. Pool No. 8, on which Morgantown, W.Va., is situated, was practically dry during October, November, and the early part of December 1930.

By the middle of July an alarming situation had also arisen on the Monongahela between the Cheat River on pool No. 7 and the Youghiogheny River on pool No. 2. The pools dropped below the crest of the dams, which impaired the navigable depth. Steps were taken at all the locks to hold water in the pools. On the upper river, the locks were sealed to conserve the pools for water supply and sanitation. When it appeared that navigation on the entire river would be suspended, arrangements were completed with the West Penn Power Company, whereby the entire volume of Lake Lynn on the Cheat River was made available for navigation purposes. Flashboards were placed on all the Monongahela River dams below the mouth of the Cheat, and the pools were refilled and maintained from storage throughout the remainder of the drought period. About 65,000 acre-ft of water was used for this purpose. Lake Lynn was drawn down considerably, but navigation continued without interruption on the lower river. This section of the river has carried as high as 29 million tons of commerce annually, and the results of the suspension of traffic for five months would have been far-reaching.

Other years have also witnessed severe droughts, notably 1908. Extensive departures from average precipitation conditions occurred in 1895, 1899, 1904, 1916, and 1922, which might well have had serious results.

As regards the effect of the reservoir on domestic and industrial water supplies and sanitation in the Monongahela valley, it is only necessary to mention that the valley as a whole has a relatively dense population and is highly industrialized. The cities, towns, and industries depend to a great extent on the river for both domestic and industrial use. Thus any great deficiency in flow or pollution of the stream may have serious consequences.

During low-water seasons the Monongahela has a relatively high acid content, largely due to pollution from mine drainage and manufacturing wastes. The principal objection to this pollution is its corrosive action on steam boilers and exposed iron and steel parts of boats, barges, and navigation structures. During periods of low water the acidity becomes especially noticeable, particularly so when rises flush out the accumulated acid in the pools. It is expected that the storage in the Tygart reservoir will be alkaline at all times owing to the character of the spring season inflow. It should therefore neutralize to a considerable extent the acidity of the Monongahela River.

Besides this effect in reducing the acidity of the river, the Tygart project will result in a dilution of its sewage content and thereby improve the quality of the water for domestic use. The water of the Monongahela also has the property of chemical hardness due mainly to the presence of sulfate and carbonates of calcium and magnesium, acquired by solution. Hardness is objectionable in water used industrially to generate steam, as well as in water for domestic supply. Since the hardness is greatest during periods of low discharge, the release of storage water, expected from its origin to be chemically soft, should result in far-reaching benefits.

This project is being designed and constructed under the supervision of the writer, with C. M. Wellons, principal engineer, in direct charge of design; J. H. Dodds, senior engineer, acting as project engineer for masonry design; and W. E. Sidney, senior engineer, acting as project engineer for equipment and mechanical appurtenances. The hydraulic aspects of the project are in charge of N. W. Bowden, M. Am. Soc. C.E., assisted by H. E. Anderson and Emil P. Schuleen, Assoc. M. Am. Soc. C.E. The field engineering and inspection organization is in charge of First Lieutenant W. E. Potter, Corps of Engineers, U. S. Army, assisted by C. H. Wagner, F. E. Barrett, and D. D. Rait. The construction is being executed by the Frederick Snare Corporation of New York, N.Y., with Lee Warren, M. Am. Soc. C.E., as construction manager.

Climatic Cycles in the West

No Direct Relation Found Between Sun Spots, Tree Rings, and Rainfall

By FRANK E. BONNER
MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
CONSULTING ENGINEER, PIEDMONT, CALIF.

IN studying the cycles of precipitation in the Pacific States, various data may be exploited. California records themselves extend back about 85 years. Then there are sun-spot numbers, which have been carefully recorded for almost two centuries. To them definite value as indicators of rainfall variations are ascribed by some investigators. Measurements of tree growth show records much farther back and so can be used to tie in all the rainfall indices. In the studies here described Mr. Bonner employed all these gages in an attempt to find some interdependence. Although forced to acknowledge a paucity of positive results, he feels his studies may prove illuminating to engineers with similar problems.

WITH public attention focused on the devastating effects of the 1934 drought, the various cyclic theories of rainfall have been commanding renewed interest. Among exponents of these theories the 11-year sun-spot period is perhaps the most popular, although the double sun-spot cycle, the 35-year Bruckner cycle, and others of different lengths find considerable support.

Some earnest investigators assume to find confirmation of the theory that climate progresses in orderly pulsations of uniform amplitude and length by measuring tree rings produced in the dim past. Others are satisfied in finding alleged correlation with the variations in the number of sun spots, which have been systematically observed since 1750.

Faced recently with the task of appraising the dependable water yield from several watersheds of the Sierra Nevada, and encouraged by the reported success of engineers who have derived estimates of water supply in other localities from sun-spot and tree-ring studies, I endeavored to utilize these devices, as noted in the February and November 1932 issues of CIVIL ENGINEERING. Although considerable time was consumed in a conscientious effort to apply all the available data beneficially, the results were disappointing. Either the relationships between climate, sun spots, and tree growth are too obscure for the unseasoned investigator to detect, or lack of coordination arises from the well-known "unusual" characteristics of the California climate. Some of the data assembled may be of interest to other

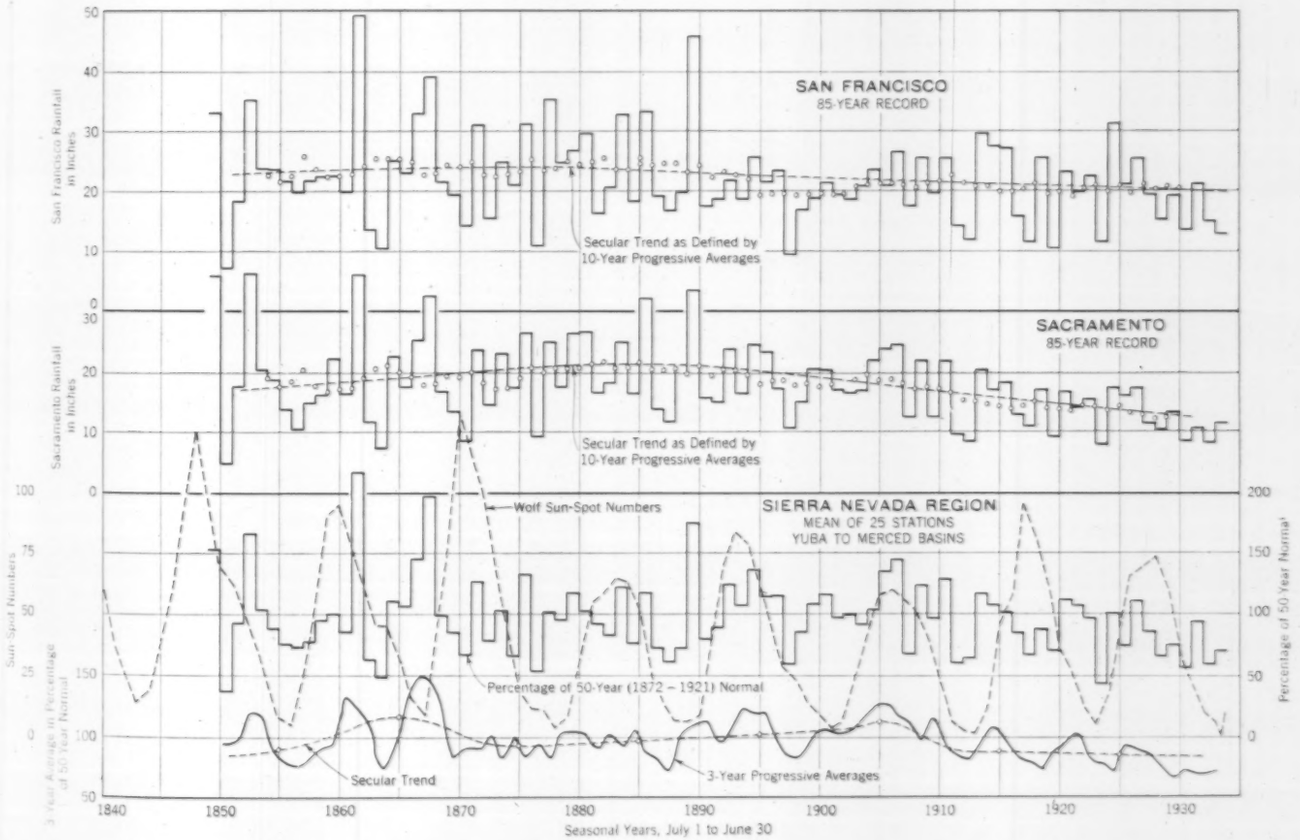


FIG. 1. YEARLY RAINFALL DATA FOR PACIFIC REGION, SHOWING VARIOUS TRENDS AND RELATION TO SUN-SPOT NUMBERS

U. S. Forest Service

STUMP OF GIANT SEQUOIA, FRESNO COUNTY, CALIFORNIA
One of the Earth's Oldest Living Things

engineers who are called upon to guess whether our comparatively recent climatological records have established true normals and extremes which may be taken as dependable guides to future water supply.

California rainfall records recognized by the U. S. Weather Bureau extend back only to 1849. The records of the San Francisco and Sacramento stations are continuous from that date, thus providing an 85-year picture. The primary water-supply problems of the state, however, relate to the measure of precipitation in the mountains of the Sierra Nevada region, from which all the more important projects for irrigation, hydro-electric development, and municipal water derive their supply. The mountain precipitation occurs mostly as heavy snowfall concentrated in the months from November to March. Melting generally begins in March and continues to early July. The resulting high-water flows have their peaks in May or June and then diminish rapidly to the negligible runoff characterizing the rainless summer and early fall months.

With one exception precipitation stations were not established in the mountain region until the sixties and they were not established in sufficient numbers to afford reliable indices until the seventies. It is necessary therefore, for conditions in the Sierra Nevada prior to 1870, to interpolate largely from the San Francisco and Sacramento records. Subsequent general conformity between the records demonstrates that this method provides a fair degree of accuracy. The San Francisco and Sacramento records are shown in Fig. 1, as is also the mean curve developed for the Sierra Nevada region. The latter is based on the records of 25 representative stations, except for the first two decades. The annual indices are expressed in percentages of the 50-year normal (1872–1921), which has been employed in hydrologic studies by the California Division of Water Resources. In an attempt to better picture long-range trends, a lower curve records the values in terms of 3-year progressive averages. The curve of Wolf sun-spot numbers is superimposed for graphic comparison with the rainfall data.

The main conclusions to be drawn from a detailed study of this diagram are that (1) precipitation in the Sierra Nevada fails to exhibit tendencies toward any rhythmic long- or short-term cycle of specific length, and (2) there is no consistent relationship between the annual rainfall and corresponding sun-spot values. During 35 years in which precipitation was above normal, sun spots were above the average in 15 years and below it in 20. During the 47 years of subnormal rainfall, sun spots

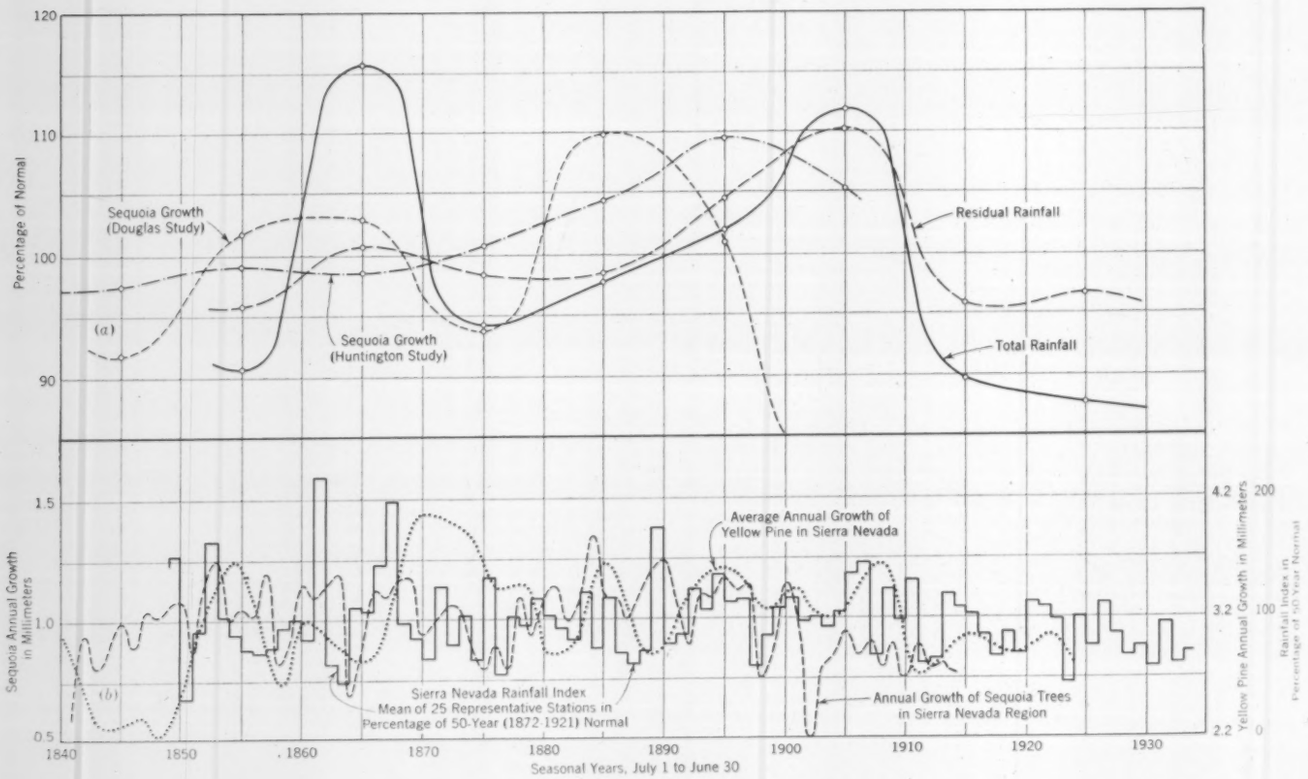


FIG. 2. RAINFALL AND TREE GROWTH COMPARED
(*a*) Percentage of Variation from Normal by Decades; (*b*) Growth by Years as Related to Rainfall in Percentage of 50-Year Normal

were above the average in 21 years and below it in 26. In the 3 years of normal rainfall, sun spots were above the average in 1 and below in 2. In this simple analysis, the sunspot–rainfall theory is correct in 41 cases, in error in 41, and undeterminate in 3. The showing is hardly good enough to qualify it as a method of prophesying weather.

In the diagram the most significant feature presented is the marked deficiency of precipitation in recent decades. No really heavy winter has occurred for 44 years. During the 41 years preceding 1890 there were 5 winters with a precipitation more than 50 per cent above normal. On the other hand, it is evident that the pioneers experienced occasional years of severe drought fully comparable with present-day deficiencies. The dryness of 1924 and 1931 was apparently equaled in 1864 and 1876, while 1850 shows the least rainfall of any.

Records for the San Francisco and Sacramento regions show a pronounced decline in rainfall over the last 50 years, but the trend in the Sierra Nevada is less definite. A gradually rising trend is evident from the dry period following the flood era of the sixties. The rise culminated in the series of years of ample rainfall in the first decade of the present century, since which time drought years have been occurring with increasing frequency.

Fortunately the results of a number of tree-growth studies of the highest order are available for the Sierra Nevada. Studies of both the yellow pine and sequoia types have been conducted by Prof. A. E. Douglass of the University of Arizona, as described in *Climatic Cycles and Tree Growth*, Vol. 2, 1928. Independent investigations of the growth of the giant sequoia were made by Dr. Ellsworth Huntington under the auspices of the Carnegie Institution, and described in *Climatic Changes*, Yale University Press, 1922.

U. S. Forest Service

UTILIZING WATER FROM THE SIERRA NEVADA
Big Creek Power House No. 1 Is Typical of Many Installations in the Area

In the accompanying Fig. 2 the upper curves compare the values, by decades, secured by Dr. Douglass and Dr. Huntington with the rainfall in the Sierra Nevada region since 1850. All values are expressed in percentages of normal. For sequoia growth the normal was derived as the average of the four decades from 1850 to 1890, which gives a result very close to Dr. Huntington's long-time normal. The rainfall values are from the curve of the Sierra Nevada in Fig. 1. In addition to the curve for total rainfall there is one for residual rainfall, which represents the departures, by decades, from the average of the rainfall indices after subtracting the surplus values in excess of normal.

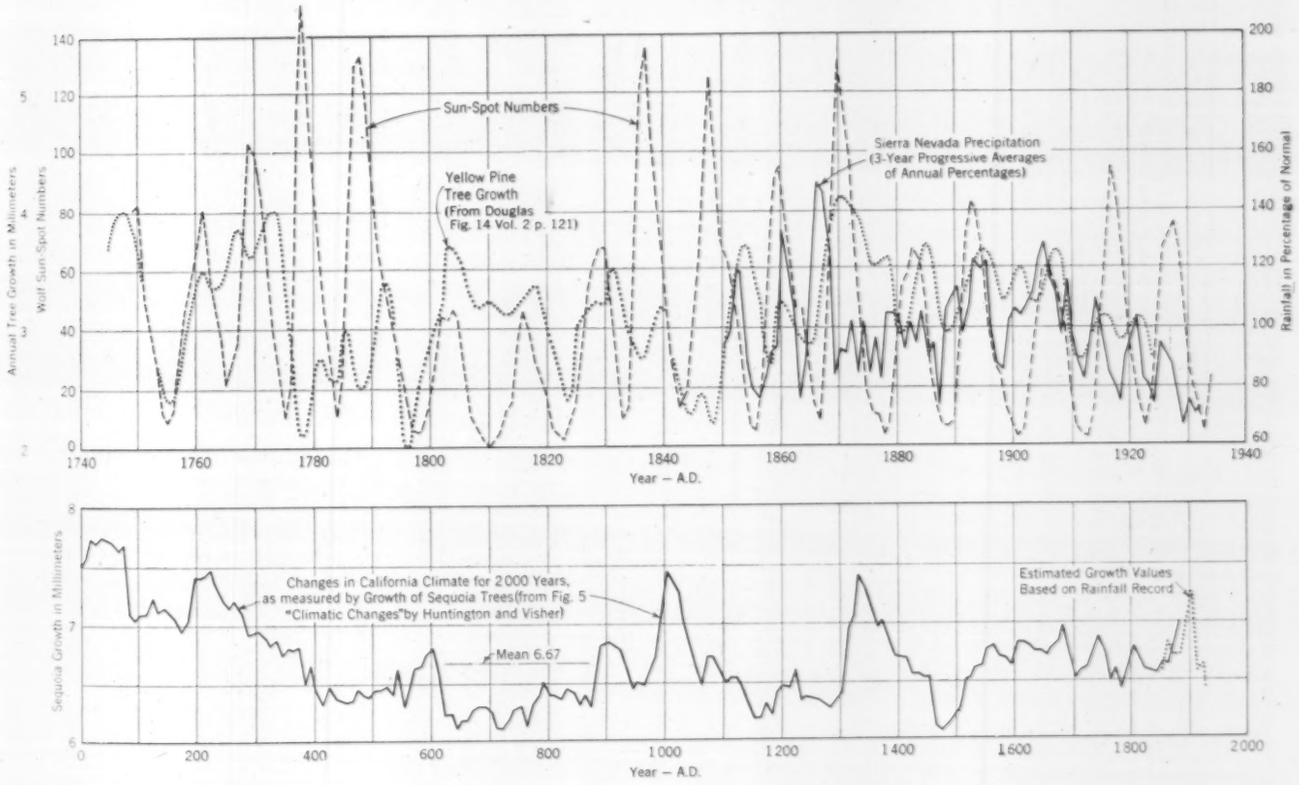
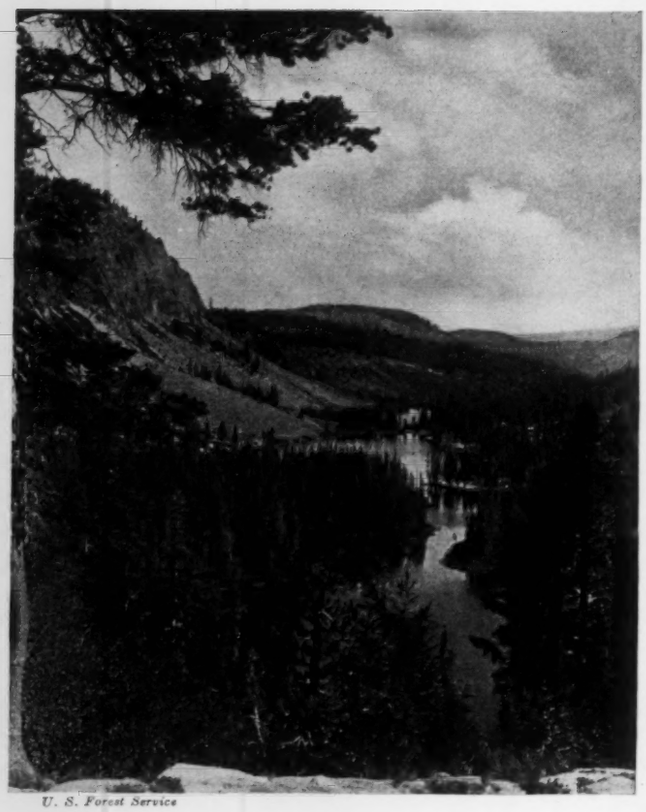

Sun-Spot Numbers
Yellow Pine Tree Growth (From Douglas Fig. 14 Vol. 2 p. 121)
Sierra Nevada Precipitation (3-Year Progressive Averages of Annual Percentages)
Annual Tree Growth in Millimeters
Wolf Sun-Spot Numbers
Rainfall in Percentage of Normal
Year – A.D.
Changes in California Climate for 2000 Years, as measured by Growth of Sequoia Trees (from Fig. 5 "Climatic Changes" by Huntington and Visher)
Mean 6.67
Estimated Growth Values Based on Rainfall Record
Sequoia Growth in Millimeters
Year – A.D.

FIG. 3. RECORD OF SUN SPOTS, RAINFALL, AND TREE GROWTH
(*a*) Relations of Sun-Spot Numbers, Tree-Ring Growth, and Precipitation; (*b*) Variations in Growth of Sequoias During Christian Era, Extended from Rainfall Records of Past 85 Years



U. S. Forest Service

TWIN LAKES, IN INYO NATIONAL FOREST
Sierra Nevada Range

It might be expected that sequoia growth would correspond more closely to this curve for residual rainfall than to that for total rainfall because an analysis of distribution indicates that abnormal precipitation, such as occurred in the season of 1861–1862 for example, would be hardly more beneficial to the growth of vegetation than normal rainfall. The comparison afforded by these curves gives no conclusive result. The growth values, by decades, taken from the two independent studies do not agree very well, and neither shows marked conformity with the fluctuations of either the total or the residual rainfall.

Turning now to the lower part of Fig. 2, the curves compare the values for annual growth derived by Dr. Douglass for both the giant sequoia and the Sierra Nevada yellow pine with annual rainfall indices. For the yellow pine, in the years when rainfall was normal or above, growth was above the average in 23 years and below in 13. With less than normal rainfall, tree rings measured above the average in 18 years and below in 21. This shows 44 hits and 31 misses for the 75 years, or an accuracy of 58 per cent.

A similar analysis of the data for the sequoia gives slightly better results. Of the 32 years when rainfall was normal or above, growth was above the average in 22 years and below it in 10. With subnormal precipitation, growth was above the average in 15 years and below the average in 18. Thus there were 40 hits and 25 misses, or agreement in 61.5 per cent of the cases. From these results it might be assumed that the past history of wet and dry years could be interpreted from the "unique language of the trees" with a margin of error slightly better than that afforded by the toss of a coin. Detailed study indicates also that tree-ring measurement would be of but little assistance in endeavoring to determine the proportional wetness of the individual seasons.

A condensed view of longer-term data is provided by Fig. 3. The upper part of the diagram compares the growth of yellow pine in the Sierra Nevada with sun-spot numbers for the past 185 years. The precipitation curve for the past 85 years is also superimposed. Disagreement and conformity are about equally in evidence.

The result seems to support the conclusion reached by C. S. Jarvis, M. Am. Soc. C.E., from his comprehensive study of world rainfall, that "No direct relation is traceable between rainfall and sun-spot periodicity.... The occasional similarities, contrasts, and synchronisms therein displayed, seem to indicate endless variety rather than conformity to any generalization." This statement appears in his paper, "Rainfall Characteristics and Their Relation to Soils and Runoff," in TRANSACTIONS, Vol. 95 (1931), page 398. Recent studies of the U. S. Weather Bureau led to a similar conclusion, as reported in *Engineering News-Record*, for July 12, 1934, page 46, by J. B. Kincer, chief of the Division of Climate and Crop Weather.

In its lower part, Fig. 3 shows variations in the growth of sequoias since the beginning of the Christian era, as developed by Dr. Huntington from the measurement of 451 stumps. An estimated equivalent growth curve that I calculated from the rainfall records is shown for the past 85 years. If it may be assumed that the variations in growth of the world's oldest trees actually do portray rainfall history in a very general way, it may be concluded that the precipitation during the 50 years preceding 1910 was a little better than the long-time average and that the drought conditions of the past two decades have been less severe in the aggregate than those existing in the seventh, eighth, twelfth, thirteenth, and fifteenth centuries. However, in view of the demonstrated inconsistencies within the period of rainfall records, it appears that even these general findings can be considered merely conjectural. One comforting conclusion may safely be drawn: the very small variation in sequoia growth over the last 20 centuries, the decade minimum being about 75 per cent of the maximum, offers convincing evidence of a remarkable degree of general stability in the California climate.

American Museum of Natural History

SECTION THROUGH A TREE THAT LIVED 1,341 YEARS
This Sequoia Washingtoniana Started Life in 550 A.D. The Section, 12 Ft Above the Ground, Is 16½ Ft Across and Weighs Nine Tons. It Is Now in the American Museum of Natural History, New York, N.Y.

For and Against the Skyscraper

Diverse Opinions as to Its Value from Both Engineering and Popular Sources

By ROBINS FLEMING
AMERICAN BRIDGE COMPANY, NEW YORK, N.Y.

THIS article traces in an informal way the course of opinion in favor of and opposed to the skyscraper since 1892, when the term "skeleton construction" first appeared in print, up to the present. Numerous quotations from every conceivable viewpoint are given; some of the earlier of these seem rather quaint today. Although his personal attitude is sympathetic, Dr. Fleming presents both sides of the controversy. His long experience in the design and construction of structural steel frame buildings particularly qualifies him to discuss this subject. Whether or not the skyscraper is desirable in its present form, it is apparently here to stay, and legislators have been content to regulate its height within certain rather broad limits. This article is an abstract of a longer paper on file for reference in the Engineering Societies Library.

BUILDING construction of the skyscraper type is now practically at a standstill. For this reason the present may be an appropriate time to make an appraisal of it. From its first appearance in Chicago until the present day, the skyscraper has been a matter of controversy from architectural, legal, public-welfare, and economic standpoints. Many of the objections once raised are now discarded; others still remain only partially answered.

The term "skeleton construction" appeared in print for the first time in "Laws Relating to Buildings in the City of New York," edited by William J. Freyer and published in *The Record and Guide*, for June 1892. The heading "Skeleton Construction" is given to the paragraph beginning, "Columns. When columns are used to support iron or steel girders carrying walls, the said columns shall be of cast-iron, wrought-iron, or rolled steel. . . ."

The files of the architectural papers of the early days of the skyscraper make interesting reading. One quotation, typical of many, will be given. The writer of a staff article in the June 22, 1889, issue of the *American Architect* says, "This is really the keynote to all of these huge buildings already built or about to be built. They are specimens of 'commercial architecture,' and as such they are unquestionably a success; but when viewed in any other way, it takes the most deceiving drawing from impossible points of sight, and with impossible sunlight and shadows, to make them even approach within hailing distance of the artistic." It is probably true that in earlier years architectural effect had little weight when in conflict with commercial interests. But the "huge oblong boxes set on end, with projecting cornice on the street front, plain walls on the side and rear, and flat roofs crowned with water tanks and pent houses" of early days are giving way to buildings which are sometimes gems of classic beauty. At other times a magnificent building will be robbed by its surroundings of the impression it would otherwise make.

NEW BUILDINGS RISE IN ROCKEFELLER CENTER, NEW YORK
A Recent Skyscraper Development

EARLY OBJECTIONS TO THE SKYSCRAPER

Early battles of the skyscraper were waged over supposed risks from corrosion, fire, and earthquake. William Sooy Smith was a distinguished engineer of his day. In an article, "The Modern Tall Building. Corrosion and Fire Dangers," in *Cassier's Magazine* for May 1902, he says, "As the metal in a steel column is usually not more than half an inch thick, corrosion at the above rate [referring to corrosion in some bridge work over railroad tracks] would make a steel building unsafe in less than twenty years." And again, "The highly inflammable buildings now erected and occupied are a disgrace to the high civilization of our age and in flagrant violation of all the well-established facts and dictates of the advanced art and science which are its distinguishing characteristics."

Let it be noted that there is no record of a many-storied building of skeleton construction having been discarded and torn down because of deterioration of the steel frame. On the contrary, it has been found that in all buildings demolished the steel frame has been in almost perfect condition. At the time of writing Smith had in mind two or three fires in skyscrapers. Since then the fire hazard, although not absolutely eliminated, has been reduced to a minimum. In a fire in the Equitable Building, New York, on the night of February 16, 1926, the flames started, raged, and died on the thirty-fifth floor. In his book, *Building to the Skies. The Romance of the Skyscraper* (London, 1934) Alfred C. Bossom says, "Of all the buildings now in existence, I should say that a modern skyscraper comes nearest to being absolutely fireproof."

Fear of earthquake shock can easily be dismissed. A monumental work is *Earthquake Damage and Earthquake Resistance*, by the late John R. Freeman, Hon. M. Am. Soc. C.E. The author says, "Our peace of mind about these matters here in the United States must rest mainly on the undoubted fact that from all that the history of 500 years has shown and all that geological research has taught, the chance is extremely small of an earthquake anywhere in populous districts in the United States or Canada equal in violence to the Japanese 'quake of September 1, 1923." It should be noted that more than 90 per cent of the loss of property in the Japan earthquake was due to fire. Professor Omori had often advised the citizens of Tokyo to improve the condition of the water

A SKYSCRAPER IN ANTWERP
The Torengebouwen, Said to Be the Tallest Building in Europe

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BOOK-CADILLAC HOTEL, DETROIT, MICH.

THE RICHFIELD OIL BUILDING, LOS ANGELES
Tower Rises to a Height of 350 Ft

pipes, but his advice was unheeded. The destruction wrought by the San Francisco earthquake of 1906 was almost wholly due to fire. A report by the National Board of Fire Underwriters, issued less than a year before the earthquake, after enumerating fire hazards of San Francisco, says, "In fact, San Francisco has violated all underwriting traditions in not burning up."

An interesting prospectus for the 42-story L. C. Smith Building in Seattle, now known as the Smith Tower, was issued in 1912 when the building was finished. At that time it was widely proclaimed as the highest building in the world outside of New York, although the claim was disputed by the designer of the steel frame of the Union Life Insurance Building of Cincinnati. The prospectus, entitled "Why Your Office Should Be in the Smith Tower," gave 19 reasons for moving into the building. One of these reasons follows: "Smith Tower Building is of steel-frame construction throughout. This insures great protection to human life during earth tremors, which occur from time to time along the Pacific Coast. During earthquakes, owing to its elasticity, the steel-frame building weaves throughout its entire length, whereas a concrete frame building is rigid and therefore subject to great damage."

The legal battles of the skyscraper have been many. The right of municipalities to regulate the height, bulk, occupancy and location of buildings has been affirmed by state courts and by the U. S. Supreme Court. The old idea that within his lot lines a man owns as far down as he can dig and as far up as he can build is outgrown. His neighbors and the community have an interest in the use to which he puts his property.

RÔLE OF THE SKYSCRAPER IN CITY PLANNING

To give a just appraisal of the skyscraper from the point of view of public welfare is difficult. Opinions from those competent to express views on the subject differ widely. Much of the literature on city planning charges the skyscraper with being a detriment to the welfare of the ideal city. Throughout the era of skyscraper construction books appeared like Koester's *Modern City Planning and Maintenance* (1914). After giving a summation of "facts" showing the uselessness of the skyscraper, he says, "There can be no question that they are an undesirable addition to any city." Williams, in *The Law of City Planning and Zoning* (1922) writes, "To the large cities of this country the tall building, since the invention of steel construction has made it possible, has become a peril. This is especially true of the very large city." The same animus is shown by articles in periodicals. The following titles are typical: "Are Skyscrapers an Asset?" "Is the Skyscraper Safe?" "Is the Skyscraper a Public Nuisance?" "Is the Skyscraper Tolerable?" "The Passing of the Skyscraper"; "Higher Buildings an Absurdity"; "The Black Shadow of the Skyscraper"; and "Overdoing the Skyscraper Program."

It has been said that the majesty of New York is measured by its tall buildings. However, Langdon W. Post, Tenement House Commissioner, has stated that in his opinion "those tall buildings are its tragedy." In his book previously mentioned, Alfred C. Bossom gives an appraisal of the skyscraper. Alluding to New York City he writes, "It could never have become one of the chief cities of the world and the unquestioned queen of the American continent without the skyscraper, without, that is to say, buildings which, by upending an entire street, economized land space, aspired toward the stratosphere, and so enabled ten people to work and make a living where three otherwise would have been a crowd." Mr. Bossom, during a practice of twenty years in the United States as an architect, designed several skyscrapers. After his return to England he entered public life and is now a member of Parliament. He profoundly believes in the skyscraper for America but writes, "I should hate to see them in Britain."

It may be interesting to follow *The Atlantic Monthly* in its policy of unfriendliness to the skyscraper, extending over the past thirty years. The October 1902 issue contains an article entitled "Limitation to the Production of Skyscrapers," by Burton J. Hendrick. After stating the "lamentable facts" resulting from the increase of skyscrapers, Mr. Hendrick concludes that "the rate of production is likely to decrease rather than increase; that the mania for bigness is subsiding and is bound to give place to a better conception of corporate eminence." This prediction was not fulfilled. In 1907 there were in New York City four record-breaking buildings in course of construction.

Referring to the issue of March 1918, William D. Parkinson, in "The Third Dimension in Land Tenure," after picturing evils incident to skyscrapers, asks the question, "And who wants to see Boston follow in New York's footsteps?" Incidentally, Boston has followed New York in regard to the height of commercial buildings. The maximum permissible height of 125 ft specified in the Building Code of 1904 was increased to 155 ft in 1923. An important change was made in 1926, permitting the erection of so-called "terraced buildings" and doing away with the height limit of 155 ft. As a result Boston had in 1929 within its city limits the 27-story United Shoe Machinery Building.

Again, in the issue of March 1930, an author writing "On the Bigness of Cities" speaks disparagingly of "the new skyscrapers springing up in New York and other cities like mushrooms in a dark cellar."

HEIGHT LIMITATIONS IMPOSED

The storm center of the whole subject of skyscraper control is the limit of height to be permitted in the fireproof commercial building. This question came up at an early date. Chicago passed an ordinance in 1892 fixing the maximum height of 150 ft. This was vetoed by the mayor. In 1893 the maximum height was established at 130 ft, in 1902 at 260 ft, in 1910 at 200 ft. The limit of height under the zoning ordinance passed April 6, 1923, is 264 ft, but towers, if set back, are permitted to be built higher. In 1910 only a dozen cities restricted the heights of buildings. In 1917 the number had increased to fifty.

SKYSCRAPERS IN NEW YORK

More than one-half of the 5,000 skyscrapers of the United States are in New York City. The Building Zone Resolution adopted July 25, 1916, now governs the height of buildings there. Both friends and foes of the skyscraper took part in the discussion that preceded the adoption of the resolution. Ten years after its adoption, a New York architect, William Orr Ludlow, writing to *The New York Times*, said, "Limiting the height of buildings was written into our zoning law to meet two demands—more sunshine, less congestion. In obtaining more sunshine the law was a success; in bringing about less congestion it was a total failure."

The maximum possible physical or engineering height is much greater than the economic height. As long ago as 1908 the *Scientific American* on the title page of its issue of July 25, presented an illustration "showing the mammoth structure 2,000 ft high which it would be possible to build upon an area 200 ft square without exceeding the building-code limit of 15 tons to the square foot foundation pressure." The Larkin Tower of New York City was designed for 108 stories above, and two below, street level. Plans and application for permit to build were filed with the Building Department in 1926. The steel design was worked out with unusual care.

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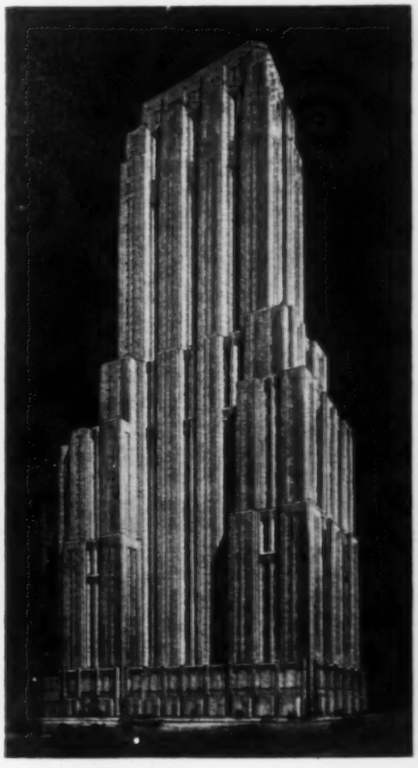
NEW YORK LIFE INSURANCE BUILDING
A Monumental Structure Occupying Old Site of Madison Square Garden



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PALMOLIVE BUILDING, CHICAGO, FROM ARTIST'S PRELIMINARY DRAWING
An Example of Graceful Proportioning

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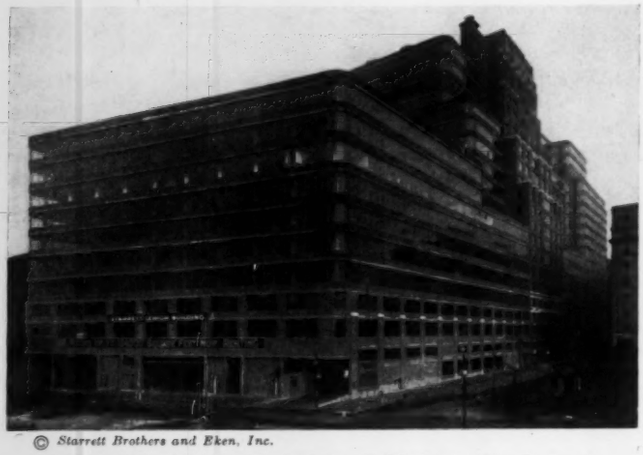
ONE OF NEW ENGLAND'S TALL BUILDINGS
Industrial Trust Company Building, Providence, R.I., Is Tallest in the City

Typical wind connections were detailed. The promoters, however, were unable to finance the project and it had to be abandoned.

In a discussion on the "Heights of Buildings" at the Annual Convention of the American Society of Civil Engineers held in London in 1900, Corydon T. Purdy, M. Am. Soc. C.E., whose opinions are always interesting, contributed a paper. The skyscraper had been in existence at that time for fifteen years, and Mr. Purdy saw the situation clearly. He wrote, "There are many things to consider in either fixing or removing limitations to the height of buildings by law. First of all, there is



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LARGE INDUSTRIAL STRUCTURE OF MODERNISTIC DESIGN

Starrett-Lehigh Building Occupies Entire Block, 26th to 27th Streets and Eleventh to Thirteenth Avenues, New York, N.Y.

popular prejudice. Then there are: the disturbing effect on land values; the exclusion of sunlight from the streets; the congestion of traffic; the increased difficulty of fire protection; the overburdening of established water supplies; the inadequacy of drainage and sewers already constructed; the disturbing effects on the business of building trades, architects, engineers, and contractors; and last but not least, esthetic consideration."

Of the considerations mentioned by Mr. Purdy, the two most important are the disturbing effect on land values and the congestion of traffic. Other considerations have been met and difficulties lessened, but these two still present to the law-making bodies of today problems difficult of solution.

DIFFICULTIES OF CONTROL

The effort to stabilize property values without injustice has been the subject of much thought. In a large city without restrictions, where there were already skyscrapers, "the system of control to be adopted must, unless it be cruelly unjust, apply equally to the existing skyscraper and to new skyscraper construction. . . . The problem of equalizing the lot of real estate owners who have, and who have not, already put up skyscrapers is one of the most serious character." This stricture appears in "City Taxation and Skyscraper Control," by George L. Hoxie, published in *The Journal of Political Economy* for February 1915. In the *Regional Plan of New York and Its Environs* (Vol. 6, 1931), it is stated that "to pyramid buildings and pieces of land in a few small areas is discriminating against property in the large expanse of land outside them."

The obvious lesson for the smaller city is to ordain without delay the control that will be needed for its future growth. The Wisconsin State Building Code of nearly twenty years ago says: "This code sets no limit to the height of a fireproof building, as it is felt that this is a matter of general community welfare rather than the safety of the individual occupants. The Industrial Commission strongly recommends that each municipality adopt such a limit, before the rise in central land values makes such action a hardship to the property owner." In this respect Cheyenne, the capital city of Wyoming, has taken time by the forelock. Its population in 1930 was 17,361, showing a healthy growth from the 13,829 of 1920. According to the zoning ordinance passed by the City Council on November 23, 1931, in the business district a maximum height equivalent to the abutting street width is allowed, except for portions of the building set back from all street, alley, and property lines a horizontal distance equal to 50 per cent of the additional heights.

The editor of *Harvard City Planning Studies* (Vol. 2, 1931) says, "Underlying the whole subject of this research is the question—do high land values necessitate tall buildings, or do tall buildings create high land values?" The anticipation that a skyscraper of some sort might be built on a city lot often increases its appraised value unduly. Thus high land values necessitate tall buildings. The great crash of 1929 in the economic world brought about many changes in values. Present tall buildings may thus necessitate high land values. It appears that in London, property values are computed on the basis of income and rent return and not on the highly speculative possibility of use of the land for skyscraper improvement.

EFFECT ON TRAFFIC CONGESTION

In large cities the problem overshadowing all others is that of traffic congestion. To what extent is this congestion due to the skyscraper? Absolutely contradictory opinions are held on the subject. In an article entitled "Skyscrapers," in *The American City* for January 1926, Frederic A. Delano, President of the American Civic Association and Chairman of the Regional Plan of New York and Its Environs, gives five of what he calls "pro-skyscraper arguments." He then gives "the arguments in rebuttal." To the third pro-skyscraper argument that there is a great convenience in concentration, he replies that "Concentration spells congestion." According to Henry H. Curran, a former president of the Borough of Manhattan, the skyscraper is responsible for traffic congestion. "The skyscraper must go," he reiterates.

In the opinion of Harvey Wiley Corbett, a distinguished architect, the skyscraper is an actual relief to street congestion. "Both are wrong, in my judgment," writes Colonel Starrett in his *Skyscrapers*. "Certainly, a building holding 10,000 workers aggravates the traffic problem for blocks around. But the high building is only one factor in a condition practically inescapable in modern urban life. The motor car is a worse offender than the skyscraper, as is demonstrated every day in such cities of relatively low sky line as Los Angeles. As well padlock Detroit. London and Paris both have rigidly limited sky lines and relatively fewer motor cars, yet their traffic problem is similar." Paul Robertson, president of the National Association of Building Owners and Managers, writes along similar lines in *The Architectural Forum* for June 1930: "One needs only to cite the congestion of London streets, where there are no skyscrapers, but with a business district spread all over the map, to show the fallacy of the argument that the skyscraper causes congestion. Boston, a low building-level city, has as great a traffic problem as New York or Chicago, where the

tallest structures are three and four times the height of Boston buildings."

Quotations pro and con on the subject could be given indefinitely. The *Harvard City Planning Studies* (Vol. 2, 1931) may also be right: "The convenience and economy in a concentration of large-bulk buildings in a small area seem so far to outweigh the inconvenience of the ordinary short periods of traffic congestion, a minus factor in determining the desirable bulk of office buildings."

"The real problem is not the prevention of the skyscraper but the control of building bulks in relation to the space about them and to the social and economic needs of the city," writes Thomas Adams in *The American City* for March 1930. "What we object to is excessive cubage," says Lawson Purdy in the September 1926 issue of the same publication.

In *The Skyscraper—A Study of the Economic Height of Modern Office Buildings* (1930), W. C. Clark and J. L. Kingston present a brief for the skyscraper. The skyscraper is studied from its economic side and the indictments that have been drawn up against it are also considered. Of course, reference is made to the traffic congestion in the city of London, where there are no skyscrapers and few concentrated building zones. The main object of the book, however, is to determine at what height the skyscraper ceases to be a profitable investment. Careful studies were made. The drastic setback requirements of the New York City zoning ordinance were followed. Engineers, architects, builders, and rental agents, all recognized authorities in their respective fields, were consulted. A conclusion drawn is, "True economic height is the resultant of a great many variable factors, of which the two most important are the size of the plot and the value of the land. Such economic height must be determined as an individual problem for each particular site. In the strategic centers of metropolitan cities in the United States, where land values are high, the owner of an office site must build a skyscraper to receive the most profitable return on his investment; the higher the value of the land, the higher he must build.

In referring to the book just described, Professor McGoldrick of Columbia University, in *The American City* for May 1930, calls attention to the fact that the costs which the authors consider are only those of the owner. "The authors let their imagination carry them to a time when the skyscraper apartment house will be piled upon the skyscraper office building and one would merely go downstairs to work after breakfast. This overlooks the very economics upon which Messrs. Clark and Kingston so stoutly insist, for it would place the residences in those portions of the buildings which they have conclusively demonstrated to be superlatively expensive."

The Committee on the Regional Plan of New York and Its Environs worked nearly ten years on the eight volumes of the "Regional Survey" and the two volumes of the "Regional Plans." Especially valuable on the subject under consideration is Vol. 6, *Buildings: Their Uses and Abuses* (1931), and Vol. 2 of "Regional Plans," *The Building of the City*. "The regulation of skyscrapers is undoubtedly the most difficult problem of zoning in every great city." Of Messrs. Clark and Kingston and their book Thomas Adams writes in the "Regional Survey," Vol. 6, page 92: "They have said everything that can be said for the skyscraper, and exposed every weakness in the objections that have been raised against it. They have not shown close grouping of skyscrapers to be desirable, nor that excessive bulk of buildings does not throw an increased burden on the land and cause congestion in addition to that caused by other forces, nor that it is necessary to crowd space so much that sunlight and fresh air cannot penetrate large parts of buildings."

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SKYSCRAPERS JOSTLE ONE ANOTHER IN LOWER MANHATTAN, NEW YORK
Illustrating Extreme Congestion

STRONG DEMAND HAS OVERSHADOWED OBJECTIONS

In view of much of the foregoing it may seem strange that such a multiplicity of skyscrapers has arisen. The reason is that there was a demand for them. These high office buildings commended themselves at once. The passenger elevator made vertical transportation easy. Offices were less noisy, more healthful, and better lighted than in the older structures. Better service, of types unknown before, could be easily obtained. Floors could be divided to suit tenants and altered at any time to suit new requirements. The new location was often more desirable than the old. To all these advantages was added business prestige. This matter of prestige often entered into the determination of height. A letter directed to the Woolworth Building dropped in any post office in the United States will reach its destination.

Mission of Boulder Dam Fulfilled

Expectations Realized in Fields of Economics, Water Use, and Recreation

By WALKER R. YOUNG

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS

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FROM all angles Boulder Dam is an American epic. In immensity of conception and romance of execution it stands supreme. Engineers like to think of it particularly in terms of a construction record. It is therefore especially gratifying to learn of its features from the man who has been in immediate charge of construction for the government. In the May issue Mr. Young gave a clear picture of the extensive preliminaries to the project; here he details the benefits already obtained and those sure to accrue. This article, like its predecessor, although independent, is part of an address delivered before the Farm Bureau Federation in Los Angeles in February 1935. Mr. Young's data show almost 50,000 people continuously supported by wages during this work, all fear of floods removed, ample water stored for irrigation and household use, the silt problem relieved, river transportation reestablished, and an abundance of electric power supplied at reasonable rates. If his optimistic expectations are fulfilled, the lake above and the river below will become a mecca for nature lovers and sportsmen. Such are the dividends promised from Boulder Dam.

ALL engineers are familiar with the basic construction and hydraulic problems of the Boulder Dam Project. Not so many appreciate the benefits incidental to this great work, including not only the immediate and varied water services, but also the attendant economic and recreational values. It may be well therefore to take an account of stock—to specify the objectives so worth while and to inquire how far and how well these glowing hopes are being realized.

Consider first the results obtained and to be expected. These may be listed as follows:

1. It will help to alleviate the serious economic situation brought about by the generally depressed conditions throughout the country.
2. It will provide flood control.
3. It will furnish an adequate water supply for irrigation and domestic use.
4. It will provide silt control.
5. It will improve navigation on the river below Black Canyon.
6. It will create a new recreational area.
7. It will permit the generation of power, the returns from the sale of which will repay the entire cost of the project.

These results will be discussed in the order named.

On July 30, 1930, President Hoover signed the Deficiency Act, carrying an appropriation of $10,660,000 for initiating construction of the project and automatically placing the power contracts in operation. Four days later Order No. 436 was signed by the Secretary of the Interior, directing the Commissioner of the Bureau of Reclamation to commence construction on Boulder Dam—and the Bureau actually put men to work at the dam site on that day.

Although not so intended in the original setup, this project became the first to aid in solving the problem of unemployment during the years of depression. Work was going forward on the drawings and designs in the Bureau's Denver office when word was received from President Hoover to start construction as soon as possible in order to aid in the alleviation of unemployment conditions. The design and drafting forces concentrated on the task of getting out the specifications for building the dam, power plant, and appurtenant works, and by working night and day made it possible to advertise for bids six months ahead of the date originally scheduled.

In April 1931 the first construction work was started in Black Canyon. As the job progressed, more and more men were hired; the new community of Boulder City was established; and materials and supplies started pouring into the project over the newly built highways and railroads. The number of men at work on construction increased to a maximum of 5,250; Boulder City grew to a population of over 6,000, the third largest town in Nevada; and Las Vegas doubled its population. The project's monthly payrolls grew to a maximum of $743,000, and millions of dollars started flowing through the channels of trade, bringing in foodstuffs, steel, machinery, cement, and other construction supplies and equipment.

From the beginning the average number of men employed has been approximately 4,000. Statistical data indicate that for every 10 men engaged in construction, 18 are employed in supplying materials. Thus, an average of approximately 11,200 men were at work on the

SOLUTION OF THE LABOR HOUSING PROBLEM
North Section of Boulder City from Water Tower Hill

project and elsewhere. Multiplying this figure by 4.1, the number of persons in the average family in the United States, it is found that approximately 46,000 persons have been fed, clothed, and housed through the expenditures for the project.

Locally the government's and contractors' payrolls during this time have been nearly $600,000 per month, and the total payments for labor and materials made by the government have amounted to more than $82,000,000.

A summary including 1934 and covering materials arriving by rail in Boulder City presents the following facts of interest. The total car loadings amounted to 27,034, which, if placed in one train would extend from Los Angeles nearly to Boulder City. These cars came from every state in the Union, although California led all others in materials. Listed among the car loadings were 16,127 of cement of which 14,000 were from California, for which the Southern California cement companies were paid $6,186,000. Other car loadings included 2,142 of steel products, 664 of machinery, 2,348 of gasoline and oil products, 2,852 of lumber, and 435 of foodstuffs.

Payment to the Union Pacific Railroad, according to government and contractors' accounts has amounted to $8,671,000. No record is available of shipments by highway, but it is known that these have been considerable, particularly of fruits and other perishables.

Great as have been the benefits from the economic standpoint, they are small in comparison with those that are accruing and will accrue because of the construction of the dam and power plant. At present, construction is under way on the power transmission lines, the Parker Dam, the aqueduct, and the All-American Canal, none of which would have been physically or economically practical without the construction at Black Canyon. Later will come the erection of factories and plants, the establishment of homes and thriving communities, and

PROVISION FOR FLOODS—ARIZONA SPILLWAY AND BRIDGE
Drum Gates at Crest Are 100 Ft Long by 16 Ft High

all the activity that will accompany the continued development of our southwestern empire.

Today Boulder Dam is nearing completion, and the lake is forming back of it. When full, Boulder Canyon Reservoir will be the largest artificial body of water in the world. It will extend upstream for a distance of 115 miles above the dam site, will have a shore line of 550 miles, a water surface area of 227 sq miles, a maximum depth of 583 ft, and a capacity of 30,500,000 acre-ft—sufficient to store two years' average flow of the Colorado River and enough to supply every man, woman, and child on earth with 5,000 gal of water, or every person in the United States with 80,000 gal. In comparison, Lake Gatun in the Panama Canal Zone holds 4,200,000 acre-ft and the Elephant Butte Reservoir on the Rio Grande project, 2,638,000 acre-ft.

FLOODS WILL BE CONTROLLED

With a reservoir of 30,500,000 acre-ft capacity, the project will control not only the lesser floods which may occur during any month of the year, but also the great

EXCAVATING THE ALL-AMERICAN CANAL
Scrapers at Work During March 1935 on a Wet Section

runoff occurring in the spring and summer months. In the past, the rate of river discharge has varied from a few thousand to more than 300,000 cu ft per sec. In planning the project, the upper 72 ft of the reservoir, having a capacity of 9,500,000 acre-ft, was reserved for flood-control purposes, and this capacity is not to be encroached upon for the storage of water except as required to control the discharge below the dam to an amount that can safely be carried through the lower valleys without the expenditure of excessive amounts of money for protective works.

In the lower delta country, protective levees have been constructed for a length of 150 miles, of which 75 miles have been destroyed by the river. In 1905 the river breached the levees and discharged uncontrolled through the Imperial Valley and into the Salton Sea for a period of 18 months. This breach was finally closed at a cost of about $2,000,000. This takes no account of large property losses suffered by the inhabitants of the district. In the absence of flood-control facilities, the cost of maintenance of levees alone has been approximately $500,000 a year, and even with this large expenditure, the menace has not been eliminated. The people live in constant fear that the river may again get out of control.

With Boulder Canyon Reservoir functioning, the volume of the large floods passing the dam site will be reduced from 200,000 cu ft per sec to 45,000, and the extreme flood from 300,000 cu ft per sec to about 75,000. With this control established, residents of the valleys need no longer fear the ravages of the river, provided of course that they do not fail, through their feeling of security, to maintain the channels and levees to carry even the greatly reduced discharges.

WATER SUPPLY RELIEVES ALL DANGER

The third effect of the project will be to provide an adequate water supply for irrigation and domestic use. Under present conditions, the average river discharge past the Boulder Dam site is approximately 16,000,000 acre-ft annually, with a new low record last year of 4,372,200 acre-ft. It is estimated that with Boulder Canyon Reservoir functioning, there will be water for

2,100,000 acres of irrigable lands lying below the dam site, including about 200,000 acres in Mexico. At present there are 660,000 acres under cultivation. Of this acreage, 450,000 lie in Imperial and Coachella valleys, which can be expanded to about 1,000,000 acres on completion of the Boulder Canyon Project.

Without the project, further expansion of irrigation is infeasible, since the natural flow of the river is already overtaxed during the peak of the irrigation season, and in a year similar to that just past there are serious shortages. One of the provisions of the All-American Canal contract is that no charge may be made by the Government for water or for the use, storage, or delivery of water for irrigation or potable purposes in Imperial and Coachella valleys. Undoubtedly the water users in these valleys must view the lake now forming back of Boulder Dam with considerable satisfaction.

COMPLETED CANAL SECTION LOOKING TOWARD IMPERIAL VALLEY
Many of These Immense Machines Were Used on the Work

BOULDER RESERVOIR USED FOR RECREATION, MARCH 1935
Boating Under Permit of U. S. Department of the Interior

Those having interests in the Metropolitan Water District of Southern California must also look upon the project with some degree of satisfaction, for it provides relief from a condition that made hazardous the further development of this area. Additional local sources of water available are not considered adequate, and it has been decided by those responsible for the study of the question that it is necessary to bring in a large supply of water from some outside source. The Colorado River is the logical source and is the only adequate source of suitable water that can be reached with reasonable cost. The plan adopted, and now being executed, is to carry 1,500 cu ft per sec drawn from storage in the Boulder Canyon Reservoir to the Pacific Coast through an aqueduct 240 miles in length, originating on the Colorado River near the town of Parker, Ariz., and terminating in reservoirs near Riverside, Calif. From this point, deliveries of water will be made through a distribution system to the various cities of the district.

This development is to be accomplished by, and at the expense of 13 municipalities in the vicinity of Los Angeles that have joined in the formation of the Metropolitan Water District of Southern California. The District has an area of 2,421 sq miles—half that of the state of Connecticut—and has a present population of 2,660,000 and an assessed valuation of three and one-half billion dollars.

Although the Government is not building the aqueduct, it is so closely related to the Boulder Canyon Project as to become an important element in the general plan for the development of the Colorado River. Water will be purchased from the Federal Government by the District at 25 cents per acre-ft and pumped over the intervening mountains by the District with electric power generated at Boulder Dam. It is estimated that the annual revenue to the Government from this operation will be $250,000.

The fourth effect of the project will be to provide silt control. The amount of silt carried to the delta annually by the Colorado River has been variously estimated at 88,000 to 137,000 acre-ft. If it may be assumed that the average is 100,000 acre-ft, and if this is expressed in terms of weight, the result is the astounding total of 175,000,000 tons transported to the delta each year. In other words the river, when carrying the average flow of about 22,000 cu ft per sec, transports its load of sand and silt past a given point at the rate of 330 tons per min.

This silt causes no end of trouble and expense to those who attempt to transport Colorado River water through canals and other irrigation works. Not only does it obstruct the diversion works, canals, and laterals, but the continuous use of silt-laden water in irrigation results in the gradual building up of the ground elevation, especially near points of distribution, with a deposit of material of questionable value.

Under present conditions, the annual cost of fighting silt in the lower valley is said to be above one million dollars. In the future, this silt will be trapped to a very large extent, if not entirely, in reservoirs, and it is expected that after a few years the river below Boulder Dam will have established itself in a stabilized channel and that the silt problem in the lower valleys will have been eliminated.

The question most often heard regarding the project is, "How soon will the reservoir fill with silt?" the inquirer usually overlooking the fact that one of the purposes of the reservoir is to store silt to the benefit of lower basin irrigators. Any answer to the question of course must be a mere guess. If the annual silt content of the river may be assumed as 100,000 acre-ft, as indicated by many measurements, and the capacity of the reservoir is 30,500,000 acre-ft, the answer would be 300 years, providing present conditions of upstream development remain unchanged.

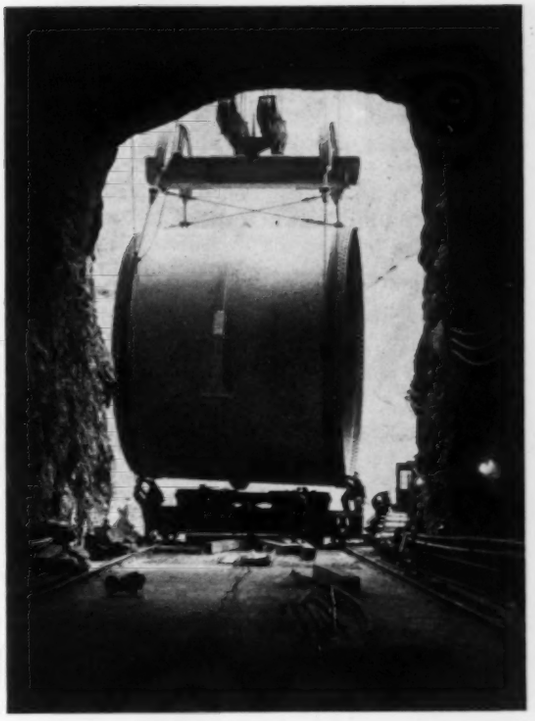
However, in the normal development of the upper basin, additional reservoirs will be built, with resulting changes in river régime. If reservoirs are created on the main river above Boulder Canyon Reservoir, they will catch the silt that otherwise would be deposited in this reservoir. It is useless to attempt to look too far into the future in this respect. The best estimate which it has been possible for the Bureau of Reclamation to make indicates a deposition of silt in Boulder Canyon Reservoir of about 3,000,000 acre-ft at the end of the 50-year repayment period established by Congress.

IMPROVED NAVIGATION

The fifth effect of the project will be to improve navigation on the river between Boulder Dam site and Im-

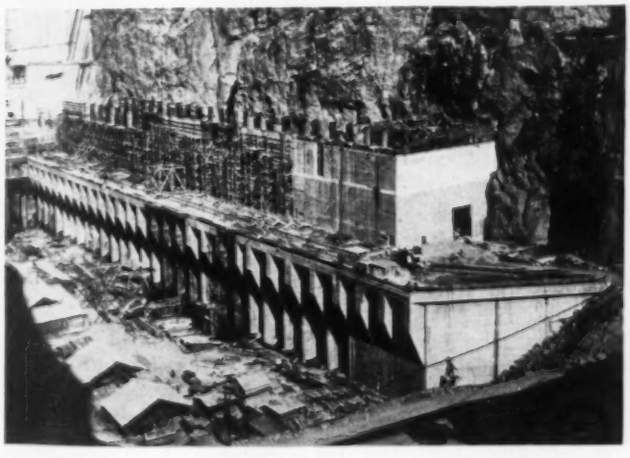
perial Dam site, the point of diversion for the All-American Canal. Technically, the Colorado is a navigable stream, but under present conditions of unregulated flow, navigation is impractical. Ordinarily the discharge at Boulder Dam varies from a minimum of about 3,000 cu ft per sec to a maximum of 150,000. In August 1934 the minimum dropped to 1,780 cu ft per sec, and in 1884 the flow is estimated to have been between 300,000 and 350,000 cu ft per sec. The river bottom is of a shifting character, and at low discharges the channels change from day to day, making navigation out of the question except for very small boats. Likewise, the river is not navigable at flood stage because of high veocities.

With the river regulated, the flow below Boulder Dam will vary ordinarily from 12,000 to 20,000 cu ft per sec, the rate of discharge through the power plant depending upon the elevation of the water surface in the reservoir and upon power requirements. The maximum flow to be expected with the river regulated will be about 45,000 cu ft per sec, which will be sufficient to control the usual seasonal flood. This may reach 75,000 cu ft per sec once in about 100 years.



A TIGHT PLACE FOR A 30-FT PENSTOCK SECTION
Landed by Cableway on Car at Entrance to Header Tunnel

Under conditions of regulated discharge, it is not unreasonable to believe that the river will be used for commercial purposes, particularly by passenger-carrying vessels, and by freight carriers in transporting farm products from some of the valleys to railroad crossings and in transporting materials and supplies on the return trip. Safe, dependable water transportation no doubt would also prove advantageous to those engaged in prospecting and in the operation of mines along the river.



ARIZONA WING OF THE POWER PLANT AS SEEN ABOUT APRIL 1, 1935
Forms Stripped from Downstream Section; Dam at Left

RECREATIONAL AREA CREATED

The sixth result of the project will be to create a new recreational area an easy day's drive from several important cities such as Reno, Nev., Salt Lake City, Utah, and Phoenix, Ariz., as well as from the large center of population in Southern California. The lake to be formed back of Boulder Dam will be unique in that it will be a beautifully clear and sparkling body of deep water in the midst of mountainous desert scenery, in places occupying narrow box canyons such as Black, Boulder, Iceberg, and the lower end of the Grand Canyon.

In the latter case, the river makes its exit from the canyon at Pierce's Ferry, Ariz., above which point the striped canyon walls, cut by numerous vertically walled side canyons, extend upward in towering fashion to the rim, a mile overhead. The side canyons above Pierce's Ferry and the many small bays below will afford an enviable opportunity for those fortunate enough to possess time and facilities to loiter in a district having particular interest for nature lovers, with its high coloring, peculiar geological formations, and traces of an early civilization. If they like, they can dangle their fishing lines in the emerald green water, for it is planned to stock the lake with various kinds of fish.

It is also predicted that the river below Boulder Dam will develop into one of the finest trout streams in this part of the country if properly stocked. This may seem a far-fetched idea to those who have known the "silvery Colorado." However, in the future, water flowing in the river and over the rapids below the dam will not be the warm, muddy water of days gone by. In contrast, it will be cold, clear water drawn from the lower elevations of the deep reservoir. Already the water fowl are taking advantage of the sanctuary created by presidential proclamation, and soon the observation of their habits and life will become an interesting pastime.

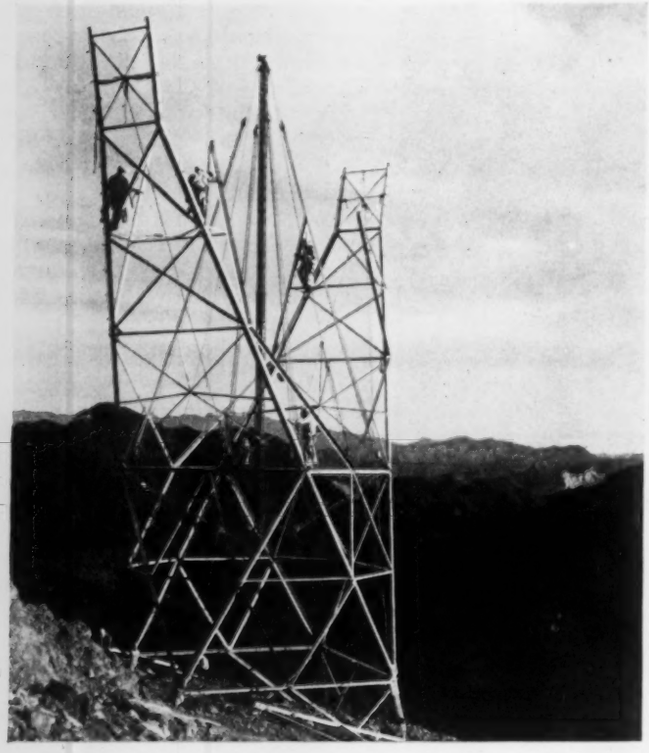
While not attractive during the hot summer months, the climate during the remainder of the year is ideal for those enjoying out-of-door life. The winter months in particular are delightful. With its scenic beauties, camp sites along the shore line, and opportunities for fishing and boating, the Boulder Canyon Reservoir should be a real asset to the Southwest. It should become an attractive tourist center. Visitors are coming to the project in increasing numbers. There were 92,000 in 1932; 133,000 in 1933; and 265,000 in 1934. It is possible that they have been attracted by the construction activities, but it is quite probable that the completed structures and the lake will continue to be of interest to those who enjoy the great out-of-doors.

POWER GENERATION EVALUATED

A final major result of the project will be the generation of power at a location near a large power market. While the generation of power is only incidental to the principal purposes of the project, it is the returns from power that will repay the cost of the project.

As the water is drawn from the reservoir to supply do-

mestic and irrigation requirements, it will be passed through hydraulic turbines actuating generators. Thus the potential energy stored up in the reservoir can be converted into electricity in large amount. For the reason that the primary functions of the reservoir are to control floods and to store water during periods of high discharge to be released during periods of low flow, the power plant will operate under a varying head. The maximum head available will be 590 ft; the minimum, 420 ft; and the average, about 530 ft.



PROGRESS ON POWER TRANSMISSION LINE NEAR BOULDER DAM
Tower of Los Angeles Bureau of Power and Light

Ultimately the installed turbine capacity will be 1,835,000 hp and the rated generator capacity, 4,333,000,000 kwhr per annum of firm power, decreasing each year by 8,760,000 kwhr owing to upstream development. In addition, there will be available a large amount of secondary power. In comparison, at Niagara Falls, in the United States, the installed capacity is 452,500 hp; and at Muscle Shoals that at present installed is 250,000 hp and the ultimate proposed is 660,000 hp. The Boulder Canyon installation consists of two 55,000-hp and fifteen 115,000-hp units. The generators of the latter units will be 40 ft in diameter, the largest high-head generators built to date.

Applications for power exceeded the supply, but as required for the use of applicants the firm power was allocated as follows:

State of Arizona	18 per cent
State of Nevada	18 per cent
Metropolitan Water District of Southern California	36 per cent
City of Los Angeles	13 per cent
Smaller municipalities	6 per cent
Southern California Edison Company	9 per cent
Total	100 per cent

The Federal Government will not sell electrical energy. According to the provisions of the Boulder Canyon Project Act, the Secretary of the Interior has contracted for the sale of falling water at rates which will repay the entire cost of the project, with interest at 4 per cent, within a period of 50 years. These rates, converted into mills per kilowatt hour, are 1.63 mills for firm power, and 0.50 mill for secondary power, both measured at the Boulder Canyon switchboard. These rates are adjustable at the end of 15 years, and every 10 years thereafter, as required to meet changing economic conditions.

Among the principal contractors for power are the Metropolitan Water District of Southern California, the City of Los Angeles, and the Southern California Edison Company. Several municipalities participate in its distribution. While the Government will retain ownership of all structures, machinery, and equipment, the power-house installation is to be paid for by the contractors for the power in ten annual instalments. The power-house machinery will be operated and maintained by the City of Los Angeles and the Southern California Edison Company under the general supervision of a director, to be appointed by the Secretary of the Interior. Contract payments are calculated to yield a total return from firm power of $354,038,270 in the 50-year period, so distributed that performance of any two will provide the minimum, $207,000,000, required for amortization of the project cost, with interest as prescribed.

Contractors for power are required to construct their own transmission lines. The City of Los Angeles and the Southern California Edison Company will build lines to the power market in Southern California, and the Metropolitan Water District of Southern California will build a line to the Parker Dam site, where electric power will be utilized to pump the District's water through the aqueduct and over the mountains to Los Angeles and other municipalities. Other transmission lines will probably be constructed later into areas in Nevada, Arizona, Utah, and California, as required to furnish electric power for mining and other purposes.

IRRIGATION PROVES ITS WORTH

In a recent report to the Secretary of the Interior, Elwood Mead, M. Am. Soc. C.E., Commissioner of Irrigation, made this significant statement:

"Recently the opinion has prevailed in some sections that further construction of irrigation works is uneconomic and injurious. It arose out of an exaggerated conception of the area irrigated under Federal works, which is less than one per cent of the total farmed area in the United States. Critics of irrigation have not realized how necessary the works being built are to the prosperity of the cities and towns and the industries located in that region. They do not understand the plight of valleys menaced with water shortages. If they did, they would join the West in energetically urging the building of storage reservoirs. It required the great drought to show to the Nation the service which the reservoirs already completed are rendering and the need for early completion of those under way."

This view is typically confirmed by a study of the aims and results of the Boulder Canyon Project. Conceived many years ago and involving matters of life and death to many communities, the Boulder Canyon Project is nearing completion as a self-liquidating investment of the Federal Government at a time when conditions demanded constructive effort to prevent demoralization. Boulder Dam has received its last concrete, and the danger of floods and droughts is forever removed from the southwestern empire. The years to come are expected to multiply the blessings to mankind from the subjugation of the Colorado River.

Tilting Glass Flume Demonstrates Value

Recently Installed Equipment Enlarges Scope of U. S. Waterways Experiment Station

By Carl E. Bentzel
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and Joseph B. Tiffany, Jr., Jun. Am. Soc. C.E.
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Ordinarily hydraulic laboratory measurements are confined largely to observations from above, although important visual observations can be made from the side if the flume is provided with glass sides. Also, a tilting mechanism is valuable in that it makes it possible to vary the slope and velocity in the model. For the first time in America both these features are combined in one installation at the U. S. Waterways Experiment Station at Vicksburg, Miss. It is expected that the studies of flow phenomena made possible by the use of this unique flume will yield valuable results. The flume, with the ingenious tilting mechanism providing unified movement, and the devices for operation and measurement are here described.

One of the most useful recent additions to the equipment of the U. S. Waterways Experiment Station at Vicksburg, Miss, is a new tilting flume equipped with glass side panels. It is 26 ft long, 1 ft wide, and 2 ft deep, and can be quickly adjusted to any slope up to a maximum of about 0.03. Installation was completed in August 1934, and preliminary tests have already shown its value.

To anyone familiar with the technic of hydraulic experimentation, the advantages to be secured by an installation of this sort are obvious. In the usual flume, whether tilting or not, observations are limited to those taken from above; and where depths of any great magnitude are used, many of the phenomena under study can be seen only with great difficulty. The use of glass walls makes it possible to study the flow of water in an entirely different way—from the sides as well as the top. By the introduction of dyes or finely powdered substances that float in a state of semi-suspension, any movement of the water becomes easily observable, either by the eye of the observer or through the medium of the camera, which can be used to record the direction of movement. The movement of bed load; the progression of riffle formations; the building of bars and the erosion of banks; the effects of turbulence, eddies, and rollers—all these can be conveniently studied.

The idea of a hydraulic flume with glass sides is not original with the Waterways Experiment Station. On the contrary, the first flumes of this type were built in the hydraulic laboratory at Karlsruhe, Germany, about twenty years ago. Since that time most of the better known laboratories in Europe and the United States have been equipped with one or more of these flumes. As far as the writers know, however, only one other installation, the Hydraulic Structures Laboratory of the Royal Technical University at Stockholm, Sweden, has combined in one structure the advantages of glass sides with those of a tilting mechanism.

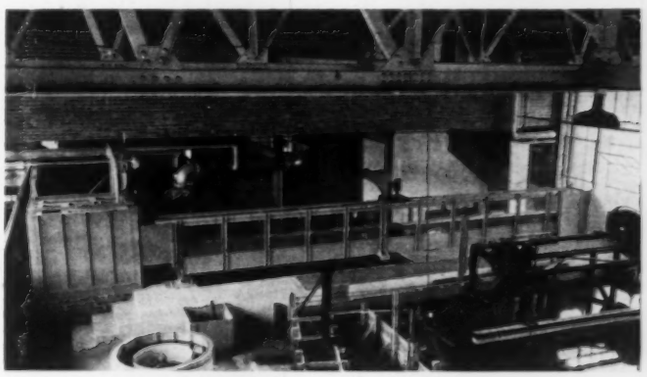
Details of Construction of Glass Flume

In addition to the 26-ft length of flume proper, the structure at Vicksburg has an additional 2-ft section of entrance channel on the upstream end and an enlarged sand trap on the downstream end. The distance between adjacent supports is $12\frac{1}{2}$ ft, making the total distance between end supports 25 ft. Below the downstream support there is a 1-ft cantilever section to which the sand trap and the tail-gate are attached, as illustrated. The width of the flume was limited by the water supply and by the fact that it was planned to use synthetic sand mixtures in the studies of bed load. These synthetic mixtures are relatively costly to prepare, and a wider flume would increase the expense by requiring a larger quantity. Furthermore it was believed that a width greater than 1 ft would make it more difficult to obtain clear photographs.

Water circulates through an overhead constant-head tank; thence through a 10-in. pipe connecting the tank to a weir box, where the discharge is measured; through a stilling chamber equipped with baffles; an entrance channel; the flume proper; a return channel to an underground storage sump; and finally through pumps, which lift the water back into the constant-head tank. The maximum capacity of the circulating system is about 5 cu ft per sec. The water is changed frequently to ensure good visibility.

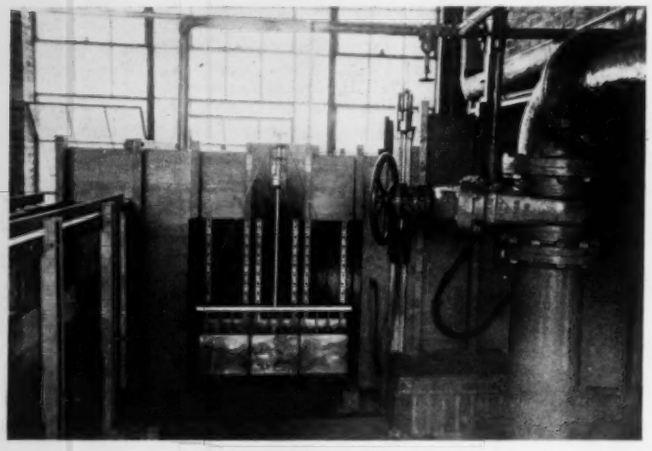
Supporting Structure Facilitates Changes in Slope

The general arrangement of the flume can best be seen in one of the accompanying photographs, which affords a general view of the flume, and in Fig. 1, a section showing the middle support. The main structure consists of two 10-in. channels supported at the ends and at the mid-point. At the upper end the support consists of a bearing pin resting on standard pillow blocks, thus providing a hinge about which the entire flume can be moved in a vertical plane. The supports at the mid-point and the lower end (Fig. 1) are specially made non-rising jack screws, provided with large square nuts, which are prevented from turning by steel flanges welded to the main structure. On top of each nut are small cylindrical rollers—one on each side of the screw—on which the main



General View of the Tilting Flume from Above
Weir Box and Stilling Chamber at Left, Flume Proper at Center, and Sand Trap at Right. Concrete Walk in Front of Flume for Use of Observers

beams rest. The jack screws are operated by a worm drive, shown in a photograph, in order to avoid distortion of the beams in changing the slope of the flume. The two worm drives are mounted on the same horizontal shaft, the drive at the lower end having a double lead and that at the mid-point having a single lead. Thus the vertical movement of the nut on the end jack is always exactly twice that of the nut on the middle jack, so that the three supports are kept in a straight line. Since each worm drive works between the two jack screws, one of the screws has right-handed, and the other left-handed threads. A rotation of the worm shaft, then, by means of a hand wheel, results in a change in the slope of the structure. At present the slope must be measured with a level and rod, but it is planned to install a vernier with which to read it directly.



BATTERY GAGE AFTER INSTALLATION
Rubber Hoses Connect Cup Wells to Pipe Outlets in the Flume

The two channels were designed as continuous beams, uniformly loaded and simply supported at three points. The principal consideration, rather than the strength of the beams, was deflection, since it was necessary that a minimum should occur under live load, thus safeguarding the glass sides against the resulting strain. Using the elastic curve equation, the total maximum deflection of the beams under both live and dead load was calculated to be 0.0206 in., and that for dead load alone, 0.0101 in. Since the plate glass was installed after the erection of the substructure, the live-load deflection alone, or 0.0105 in., was considered allowable on the glass. Experience with the completed structure, through a complete range of slopes, and with the flume both empty and full of water, has verified the reasonableness of this assumption, for in nearly a year's operation only two plates have been broken. Both of these were cracked from temperature stresses resulting from the use of water much colder than the air surrounding the flume.

SEALING THE GLASS SIDE WALLS

The side walls of the flume consist of $^1/_2$-in. double-strength plate-glass panels, 24 by 30 in., supported laterally by vertical 3-in. channels (Fig. 1). Between the steel holders and the glass are thick gaskets of soft rubber, which effect a water-tight seal. The vertical joints are sealed with aquarium cement, which remains soft and pliable, permitting the glass to expand.

Some difficulty was experienced in making the joints at the bottom water-tight. This was overcome by covering them all with aquarium cement, which proved admirably suited to the purpose. The joint at the upper end of the flume proper, between the flume and the entrance section, also required careful treatment. This joint was complicated by the fact that the rotation of the flume about the hinge, which is almost a foot below the bottom of the flume, resulted in a maximum horizontal movement of the flume at the joint of about 0.03 ft. Rubber gaskets were used at this point, so arranged as to permit movement of the flume without leakage through the joint.

Adjustable steel straight edges were installed, one at each side on the top of the flume. These support various sliding measuring devices. Control of the water surface near the lower end of the flume is obtained from the adjustable steel tail-gate illustrated. This gate slides in vertical guides and is operated by a sprocket and chain. Leakage around the gate is prevented by rubber gaskets.

DEVICES FOR MEASURING WATER AND SAND

Discharge is measured over a 90-deg V-notch weir plate, which has been carefully calibrated and found to follow very closely the equation given in King's handbook, $Q = 2.52\ H^{2.47}$. The discharge is controlled by a valve on the 10-in. feeder line, and a fine adjustment is secured by flow from a 2-in. side line.

In order to measure discharges below 0.0085 cu ft per sec, corresponding to a head on the triangular weir of 0.1 ft, an auxiliary orifice box has been installed and fitted with a brass plate in which two sharp-edged orifices have been drilled, with diameters of 1 in. and $^5/_8$ in. These orifices were calibrated through a range of discharges from 0.0038 to 0.0374 cu ft per sec, extending well into the range of discharge of the triangular weir. The orifice box is fed through a 2-in. pipe line connected to the main 10-in. line above the main valve. It is planned to use this installation for measuring the very low flows in the laminar flow range.

Measurement of the rate of movement of sand or other materials in the flume is made possible by the installation of the sand trap at the lower end. This is an enlarged section into which the water flows immediately after leaving the flume proper, and in which the velocity is sufficiently lessened so that grains of the size usually studied are deposited. The bottom of the trap is funnel shaped and drains into a 2-in. pipe line equipped with a valve. During the course of a test, the sand settles in this funnel and in the pipe above the valve. To measure the sand, the valve is opened and the

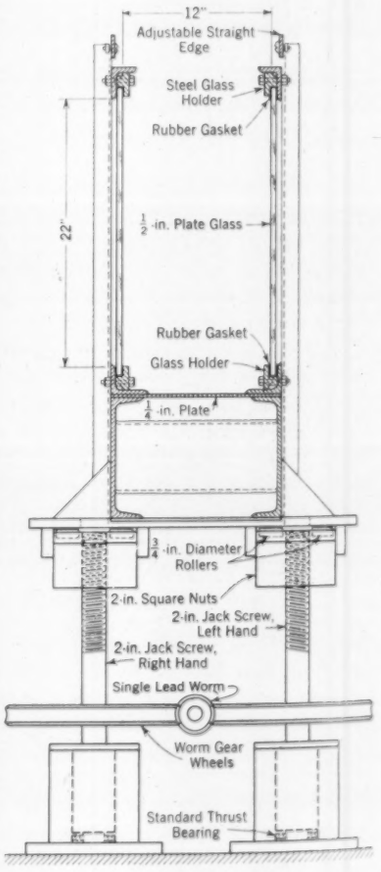


FIG. 1. CROSS SECTION OF FLUME SHOWING MIDDLE SUPPORT

sand is flushed through the pipe into a removable box with sides of fine screen wire, which retains the sand and passes the water.

GAGES DETERMINE WATER-SURFACE ELEVATIONS

Another feature of the new installation is an improved battery gage for determining water-surface elevations. In this device 12 hook gages are connected to the same horizontal bar, which is attached to a standard gage rod with a vernier scale, as illustrated. Each of the hook gages is used to measure the water surface in one of the 12 cups, which are connected by hoses to outlets on the sides of the flume. The advantage of this arrangement over the usual one, in which one gage is arranged to slide along a horizontal rod, is that fewer movements are required. Furthermore, since the hooks are always under water, no error is introduced, as in the old type, by the sudden displacement of water when the hook is lowered into the cup. The gage points are readily zeroed by lowering them into a small trough of water and setting the individual points by means of their adjustment nuts. This is the first gage of this type in use at the experiment station. However, at the present time, in May 1935, gages of this types are being designed for use in a new model of the Mississippi River under construction at the experiment station.

In addition to the battery gage, a point gage has been mounted on a frame which slides along the side rails on top of the flume. Since these rails are always set to the same slope as the bed of the flume, the sliding gage is well adapted for measuring slope and depth, and for taking profiles of sand beds. This is especially true where uniform flow is desired in the flume. Since the surface of the bed and the rails are made parallel, for uniform flow to exist the sliding-gage reading on the water surface must be the same at all points along the flume.

It is planned eventually to install a manometer rack to provide a visual check on the slope of the water surface. Outlets on the side of the flume will be connected by hoses to a battery of vertical glass tubes, which will be mounted against a background of cross-section paper.

EXPERIMENTS PLANNED FOR THE NEW FLUME

As the principal functions of the Waterways Experiment Station are concerned with flood-control and navigation projects on the Mississippi River, the primary purpose of the new glass flume is to aid in the solution of problems connected with models of this river. (It should be noted, however, that more and more problems are being studied for engineer districts concerned with other than Mississippi problems, and at this time there are five such experiments under way at the station.) Problems of interpretation are continually arising from these studies, especially in the case of movable bed models, which constitute the majority of the models at the station. A number of these problems are to be studied in the new flume, in which it will be possible to hold most of the contributing factors constant and to vary only those whose effect it is desired to know. Several of the problems which have been studied in the flume will be discussed briefly.

Movement of bed-load materials is a problem which must be faced by any laboratory conducting experiments on movable-bed river models. This problem has two phases: First, it is necessary to understand the laws governing the movement of the materials in the river and to know both at what stage of the river movement begins and at what rate the material moves at each stage; second, the laws governing the similar movement of materials in the model must be known. If the results from tests on movable-bed models are to be interpreted intelligently, the laboratory staff must be thoroughly familiar with both these phases.

Studies of the problem have been under way for about two and a half years at the station, and are being correlated closely with observations being made in the field. In the latter connection, over 700 samples of bed material

CLOSE-UP VIEW OF THE MECHANISM FOR TILTING THE FLUME

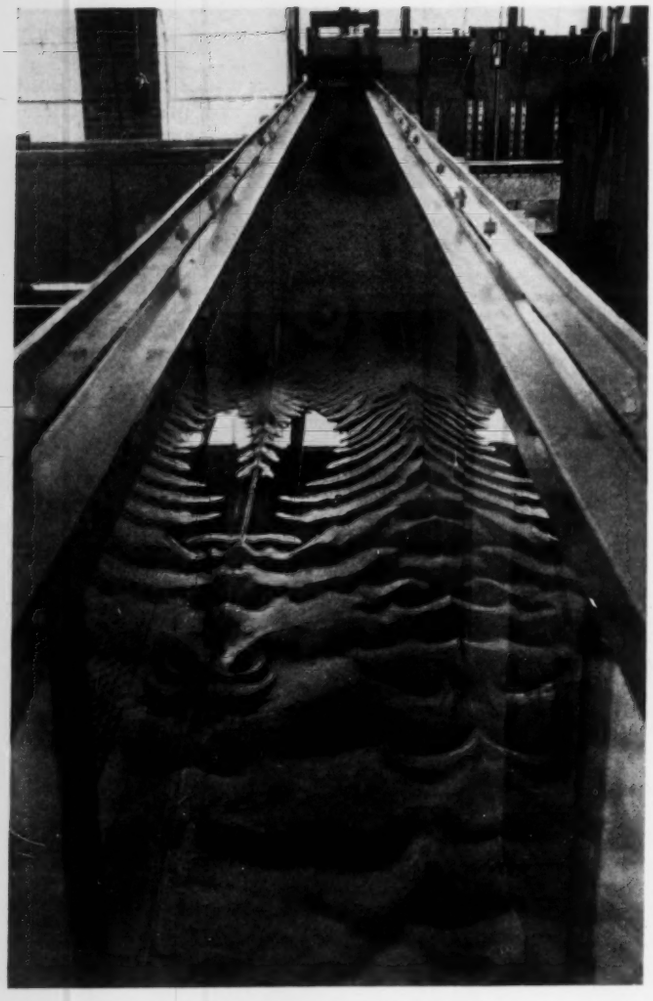
have been taken from the Mississippi between Cairo, Ill., and the Gulf of Mexico, from the major outlets, and from many of the tributaries. These samples have been analyzed in the soil mechanics laboratory of the experiment station, and the results have been studied closely to determine progressive downstream variation of materials in the river. All the analyses, with a preliminary study of the variations, are tabulated in Paper 17 of the station, entitled "Studies of River Bed Materials and Their Movement, with Special Reference to the Lower Mississippi River," printed in May 1935.

Studies in the field are being correlated with studies in the flume. In the two years 1933–1934 nine sand mixtures were tested in a tilting flume at the station, through a limited range of depths and slopes. A very complete series of observations was made of depth; slope; water temperature; area of flow; mean, surface, and bottom velocities; and rate of bed movement. These data, along with such computed information as roughness values and Reynolds' numbers, were tabulated and are presented in full in Paper 17 of the station, previously mentioned. Accompanying the tables is a complete discussion of the results of the study based on the observations. A brief report on a part of these studies is contained in a discussion in the December 1934 PROCEEDINGS, by the writers, on the paper by Hans Kramer, M. Am. Soc. C.E., "Sand Mixtures and Sand Movement in Fluvial Models."

It is intended to continue these studies of bed load in the new glass tilting flume, where it will be possible to observe the phenomena much more closely. These tests will be conducted with synthetic sand mixtures in such manner that the individual effects of depth, slope, velocity, mean grain size of bed material, distribution of sizes, and ratio of voids, can be isolated. It is hoped that the true relation of the several factors affecting the movement of bed load can be discovered.

The current study being made in the flume (May 1935) is a bed-load study to determine the effect of the size and distribution of sand grains on the size of riffles. The purpose of this study is to discover, if possible, a suitable mixture which will form riffles of minimum size in the range of slopes and depths usually obtained in movable-bed river models.

Another study, on the scour occurring downstream



LONGITUDINAL VIEW OF FLUME, AFTER SEVERAL HOURS OF A TEST RUN TO ASCERTAIN THE SCOURING EFFECT BELOW THE SILL
Note Riffle Formations and Scour

from a shallow submerged sill, was concerned with a condition which exists in the South Pass of the Mississippi River, about 10 miles above its mouth. A scour hole immediately downstream from the head of the pass has increased in maximum depth from about 88 ft in 1917, when the sill was constructed, to about 129 ft in 1932. Whether the scour was induced entirely by the sill, entirely by other conditions, or by the sill in combination with other conditions, was the subject of one of the first investigations in the flume. It was found impracticable to reproduce this phenomenon in section, however, since the effect of channel curvature, channel contraction and expansion, and other factors, outweighed the effect of the sill. Although much information of general value was obtained from the flume study, a model of the passes of the Mississippi River was used to obtain the solution to the problem of South Pass.

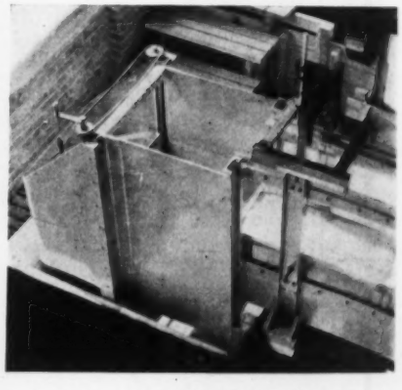
Staff members of the station, in cooperation with representatives of the Mississippi River Commission and the Vicksburg Engineer District, have been experimenting with a sediment trap, with which it is hoped that quantitative determinations can be made of the movement of bed load in the Mississippi. In order to determine the best design, including both the shape of the trap and the location of the guide vanes, tests were made in the glass flume of models of three types. The bases for comparing the three styles were the turbulence induced by the traps, the disturbance caused in a sand bed by turbulence when the traps were suspended close to the bed, and their stability. It was found that a streamlined model created the least turbulence and caused the least disturbance to the sand bed; and that the stability was largely determined by the design of the vanes.

The effect of the turbidity of water on the movement of bed load was the subject of a recent investigation. Several hundred observations were taken of the rate of movement of a sand mixture at various depths and slopes, for turbidities ranging from zero to a maximum of about 1,200 ppm. It was found that the rate of movement increased with increased turbidity, provided the test had not been preceded by a settlement period, when quiet, turbid water was allowed to deposit sediment on the sand surface. When the turbid water was allowed to stand over the bed for a period of about 16 hr, however, it was found that the rate of movement decreased with increased turbidity, owing to a clogging of the surface sand grains.

Small-scale levee sections have been used in the flume to study seepage lines. The effect of the river-side and land-side slopes on the position of the seepage line has been investigated, the lines being traced through the levee section by means of dyes injected on the river-side face. These studies are being continued on a larger scale in the large steel flume at the station, in which a 27-ft section of glass side-panels has recently been installed.

PHOTOGRAPHS AS AN AID TO FLUME STUDIES

Photographs are being extensively used as an aid in recording observations on tests made with the new flume. Many flow phenomena which occur too rapidly to be followed readily by the eye can be recorded by a camera with a fast lens, or by a moving-picture camera, and can then be studied more thoroughly from the photographs or by projection on a screen. This method is especially convenient for use with the new flume, whose glass walls permit clear side shots of flow phenomena. In particular, eddies, rollers, turbulences, and the dune movement of sand grains can be conveniently photographed.



OVERHEAD VIEW OF SAND TRAP AND TAILGATE
Sprocket and Chain Operates the Gate, and Sliding Needle Gage Is Mounted on the Rails

The glass tilting flume was designed by Carl E. Bentzel, formerly research assistant at the U. S. Waterways Experiment Station, now assistant engineer with the Tennessee Valley Authority, under the direction of Herbert D. Vogel, Assoc. M. Am. Soc. C.E., former director of the station. It was erected by the laboratory construction crew under the supervision of H. T. Long, Jun. Am. Soc. C.E., assistant engineer. The U. S. Engineer Department shops at Vicksburg built the steel structure and the tilting mechanism. The flume will be operated by the research group, supervised by Joseph B. Tiffany, Jr., Jun. Am. Soc. C.E., research assistant at the station, under the direction of F. H. Falkner, Jun. Am. Soc. C.E., the present director.

Constructing Highways in Colombia

Inaccessibility and Tropical Climate Handicap Building of Through Routes

By Albert A. Mittag

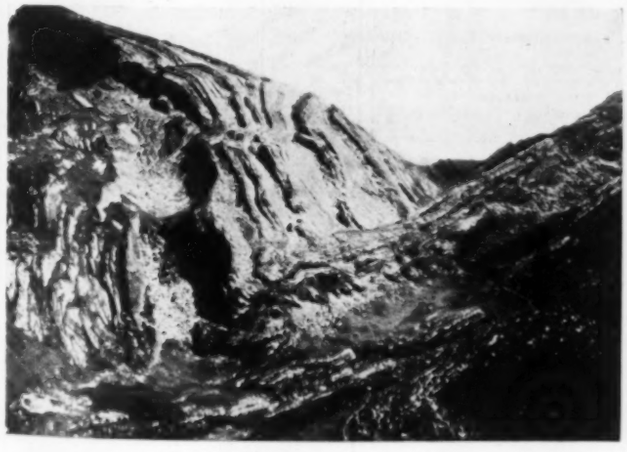
Associate Member American Society of Civil Engineers

Engineer in Charge of Construction, Pan American Airways, Inc., Island of Midway, Pacific Ocean

Until recently, Colombia has made little progress in road building. Except in a few populous districts, the roads still consist mainly of trails climbing and descending through the mountains at sharp angles and clinging precariously to the sides of deep gorges. Travel on these is generally by mule. Bogotá, the capital, lies in the interior on the Magdalena River, which is the principal artery of traffic. On account of shallows and rapids in the river, imports must be transferred between steamers and railroad six times to reach the city. In recent years, the Colombian government has embarked on an extensive road-building program to provide through routes in the more populous sections. Mr. Mittag served in a responsible capacity on two of these. Although he discusses the work from an engineering point of view, the problems presented take on in some degree the picturesque qualities of the country.

Occupying the northernmost part of the continent of South America, Colombia embodies the tropics of the Amazon, Cauca, Atrato, and Magdalena River valleys; the perpetual spring of the table-lands of Medellín, Bucaramanga, and Popayan; and the cold of the paramos, those great plains that extend throughout the republic at altitudes of from 10,000 to 12,000 ft. Colombia has an area of about 450,000 sq miles, approximately equal to the combined area of the states of Texas, New Mexico, Louisiana, and New Jersey. It extends from the Atlantic and the Caribbean to the Pacific, bordering the countries of Panama, Peru, Brazil, Ecuador, and Venezuela, and has an exit to the Amazon valley through the much disputed port of Leticia. Three great ranges of the Andes—the Eastern, Central, and Western Cordilleras—further add to the ruggedness and isolation of the country. Colombia is rich in minerals, hard woods, and oil, and raises large quantities of bananas, coffee, cocoa, vegetables, cotton, and cattle.

Bogotá, the capital, with a population of 250,000, is on a plateau at an elevation of 8,890 ft. Barranquilla, the second largest city, lies some 18 miles from the mouth of the Magdalena River at sea level. Medellín lies in the beautiful valley of the Rio Porce, at an elevation of 4,917 ft and is the starting point of the Carretera-al-Mar, a highway winding tortuously to the sea. Other cities of importance are Cartagena, the old port of the Spanish Main; Cúcuta, the entrance through Venezuela; Cali, on the road from Buenaventura, the Pacific port, to Bogotá; and Bucaramanga, the starting point of the Bucaramanga-Mortiño Highway. The cities mentioned have a combined population of 800,000, which is 10 per cent of the total population. About 40 per cent is to be found in the smaller cities, and the other 50 per cent is widely scattered over 450,000 sq miles.



Fold of the Pass of Perico, Colombia

Trough of Fold at Elevation 13,000 Ft, and Pass Proper, at 13,500; Mortiño Highway Visible at Middle Right

Transportation in Colombia is still in its infancy. The conquistadores built some excellent trails and ox-cart roads over the Andes and down the Cauca and Magdalena River valleys connecting Bogotá with Cartagena. Evidences of one of these roads may still be encountered in the Cauca valley.

Prior to 1928 there existed practically no modern highways. Today there is probably nowhere in the republic a continuous stretch of more than 60 miles of modern highway. There are innumerable dirt roads, which are fair in the dry season but which, with the advent of the rainy season, soon become quagmires and are utterly impassable. Between the cities of Cartagena and Barranquilla, 62 miles apart, there is no road that is open the year round, although the terrain offers no difficulties whatsoever to the road builder.

The appalling lack of adequate communication between the various parts of the country may be best explained by an example. Medellín and Bucaramanga (Fig. 1) are 199 miles apart as the crow flies, yet a trip between them for those who cannot afford to go by air takes from five to twelve days, depending on the season, wet or dry. The traveler proceeds by automobile from Bucaramanga to the rail head, a distance of 12 miles, then for 62 miles by narrow-gage railway to Puerto Wilches, there to wait until an up-river boat, preferably an express, comes along. It takes from three to ten days to Puerto Berrio, depending on the condition of the river. Thence it is a day's train ride to Medellín.

There have been only five road projects of any considerable magnitude in Colombia in the past seven years. These are the Cúcuta-Bogota, the Carretera-al-Mar (from Medellín), the Bucaramanga-Mortiño, the Carretera-al-Mar (from Cali), and the Bucaramanga-San Gil. Of these, the first three are the largest, and the second and third are those with which I was connected and with which this article deals.

Construction of the Carretera-al-Mar

The Carretera-al-Mar (Figs. 2 and 3) of the Department of Antioquia starts at Medellín, the capital, at an elevation of 4,917 ft, runs up the valley of the Rio Porce

to the town of Robledo, and from there climbs to the pass of Boqueron de San Cristóbal, at an elevation of 8,361 ft in 12 miles. Then in 23 miles it drops to the town of San Jeronimo at an elevation of 2,440 ft. From San Jeronimo to Sopetran and Antioquia there is a good metaled road passable the year round. This road crosses the Cauca River over an old suspension bridge described by F. R. Molther, M. Am. Soc. C.E., in the January 1934 issue of CIVIL ENGINEERING. From Antioquia a bench has been cut for some 25 miles to and through the pass of Boqueron de Toyo at an elevation of 7,065 ft, but little stone has been put down. Between Cañasgordas and Pavorondocito little construction work has been done. From Pavorondocito to Turbo only a caterpillar trail or construction road exists. This has no commercial value and was built to get materials to this end of the work, but through disuse it has become largely grown over with tropical vegetation.

TRANSPORTING CORRUGATED IRON PIPE IN THE ANDES
On the Carretera-al-Mar, Colombia

For thirty years it had been the dream of the Antioqueños to have a highway to the sea, and in 1926–1929 this was in a fair way to be realized. But as usual more was projected than could be accomplished. From Fig. 1 it can be readily seen why Antioquia is so anxious to build a road to the sea. Its freight must come through either Cartagena or Puerto Colombia, where it is put on trains and transferred to river boats either at Calamar or Barranquilla. Then it goes up the Magdalena River to Puerto Berrio, a trip normally requiring from 5 to 6 days for a freighter, but often taking a full month when the river is low. At Berrio the freight is again rehandled over the department railroad to Medellín.

Work on the Carretera-al-Mar from Medellín was at first done by day labor, that is, by labor working directly for the administration or the contractor. After several months of experience this method was discarded and the subcontract system was initiated. By this system a group of workmen, generally four to ten men, combine to take a contract for the excavation and rough grading of from 20 to 100 m (66 to 330 ft) of highway. The metric system was used throughout the work, since it is the legal measure in Colombia. The workmen were paid purely on a cubature basis calculated before any work was done. Payments were made on an estimate prepared by the engineer of the section at 10-day intervals. At a later date, payments were made at 15-day intervals, on the first and fifteenth of the month, this for the simple reason that the subcontractors were increasing at such a rate that it was a physical impossibility for the engineer and his assistants to take measurements along a section of from 10 to 15 km (6.2 to 9.3 miles) every ten days and compute the volume of excavation. At one time in June and July of 1928, I had over 200 active contracts on an 11-km (6 8-mile) stretch. Tools were loaned to the subcontractors, who gave receipts for them. Final payments were made only on a clearance from the storekeeper. In rock, dynamite was estimated at the kilogram for every 4 m and was charged at cost to the subcontractor to be deducted from his semimonthly estimate.

THE BUCARAMANGA-MORTIÑO HIGHWAY

Completion of the Cúcuta-Bogotá Highway brings to the foreground the economic necessity of finishing the Bucaramanga-Mortiño Highway to connect with it. Its completion would connect three important cities in an otherwise isolated country. Cúcuta, readily reached by boat, train, and automobile from Maracaibo, Venezuela, is two days from Bogotá over the new highway and is the gateway for considerable freight for the capital and Bucaramanga. Connecting Cúcuta and Bucaramanga there is only a mule trail over the paramos of the Eastern Cordilleras. It is a cold, lonely trip and requires two days. Bucaramanga is the capital of the Department of Santander del Norte and is the center of a very rich agricultural and tobacco-growing district. Its port on the Magdalena River is Puerto Wilches, 75 miles distant from it and at the head of the all-year navigable channel.

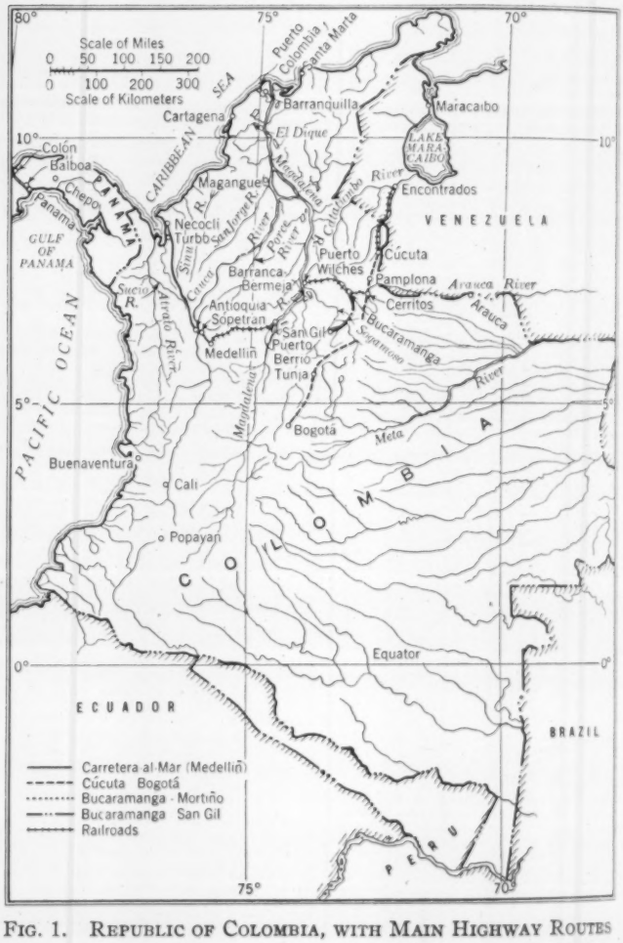


FIG. 1. REPUBLIC OF COLOMBIA, WITH MAIN HIGHWAY ROUTES

In 1928 work was begun on the preliminary survey for the Bucaramanga-Mortiño Highway, and in the spring of 1929 the location survey and construction of the road were carried on simultaneously. The preliminary line showed a possible length of 75 miles. The proposed

road (Fig. 4) was to start on the outskirts of Bucaramanga at an elevation of 3,281 ft, climb to the paramos at an elevation of from 10,000 to 12,000 ft, continue over the pass to Perico, proceed around the valley, and then connect with the main Cúcuta-Bogotá Highway just above the town of Cerritos.

The route extends from the tropics of Bucaramanga to the cold and barren paramos, where production is limited to a few head of cattle and some potatoes. The natives do little but follow the sun around the adobe huts, absorbing what warmth it has to impart. Except in the immediate vicinity of Bucaramanga, there is slight possibility of collecting the cost of the road from the country it passes through. Its main purpose is to provide another outlet to the coast and Bogotá.

On the Bucaramanga road the practice of alloting subcontracts of one kilometer (0.6 mile) was begun, but the dissatisfaction of the workers soon compelled the contractor to revert to smaller sections. On this contract sections were generally apportioned in multiples of 100 m (328 ft), and seldom exceeded 500 m (1,640 ft). Another reason was to expedite the work. It was noticed that where large contracts were awarded, the workers would start on the easiest part, which afforded the highest rate of pay, and when the digging became hard would desert and leave the more difficult and expensive final grading to be done by the administration.

METHODS AND MACHINERY FOR EXCAVATION

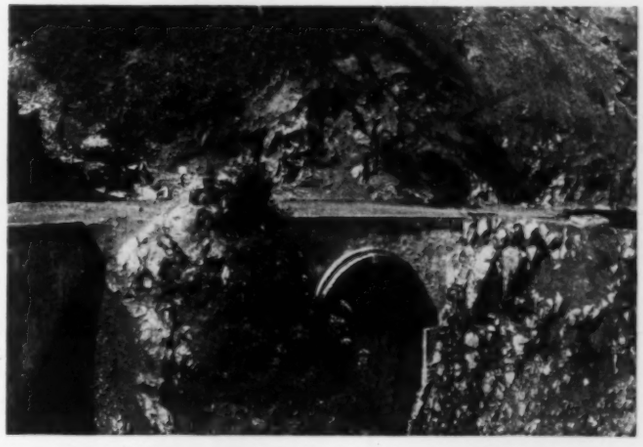
Owing to the inaccessibility of the work, the use of modern earth-moving equipment such as power shovels, scrapers, and bull-dozers was out of the question. This meant that contractors had to resort to pick and shovel and wheelbarrow. Because of the excessive steepness of the terrain, fills of any size were the exception and the road was generally cut into the bank to assure a safe bench. Also, it was good insurance against slides to keep close to the edge of the slope and minimize the cut.

FIG. 2. CARRETERA-AL-MAR, FROM MEDELLÍN TO THE SEA

When practicable, compaction was secured by allowing the fill to stand through a wet season. Otherwise fills were built up in layers of one meter and compacted only by the rolling of the wheelbarrows and the waking of the peons. Because of the excessive precipitation, any attempt to move earth during the rainy season is a waste of time and money. Since lumber is scarce and costly in Colombia, runways are out of the question, and the clayey nature of the soil makes the job both heart- and back-breaking.

On the Carretera, various methods were tried to prevent or combat the numerous slides encountered. It may be safely estimated that at least 40 per cent of the total cubage handled on this project or similar ones was made up of slide material. One plan tried was to go some 5 m (16 ft 5 in.) above the peak of a cut as a zero point and excavate a ditch to the nearest culvert with the minimum amount of grade to prevent excessive erosion. In places where the soil was firm, this method worked well, but in others erosion and seepage from the ditch to the road soon developed "just another slide."

On the Mortiño Highway, also, considerable difficulty was encountered with slides. Earth in cuts and on side hills was given a slope of 1:1 to eliminate slides, but as soon as the rains started and the ground became thoroughly saturated, down they would come. Rock was cut on a slope of $^1/_4$:1, and care was taken to clean out all loose material. In several sections no effort was made to put in drainage ditches over cuts to divert the rainfall; it was allowed to follow natural drainage channels.



MASONRY AND BRICK ARCH ON THE CARRETERA-AL-MAR

Where such channels crossed the road, culverts were provided.

It seems to me that the practice initiated on the International Railroad in Salvador of making all cuts as vertical as possible, that is $^1/_4$:1, is the best practice in these regions. The percentage of cuts that stood up from one rainy season to the next without serious slides was very high. Certainly this practice deserves serious consideration by engineers working in the tropics.

Owing to the fact that Colombia is liberally sprinkled with mines, many of the laborers have had experience in using hand drills and dynamite; and their use of the latter is enough to make the average person a bit nervous. When rock was encountered on the Carretera, miners were brought over from the mines of Segovia. The major difficulties experienced with these miners was in getting them to drill deep holes—for their idea of a deep hole was anything up to 6 in. that went off with a bang—and to eliminate the use of mudcaps, which were often promiscuously slapped on hot rock with distressing results.

On several stretches of the Carretera the road is cut in solid granite. On one such piece, for a distance of $1^1/_4$ miles, the bench is cut in this granite with an overburden of 115 ft. And when it is realized that no machinery of any kind whatsoever was used for drilling, some idea of the work involved may be formed.

On the Mortiño road, on that part where work was in progress when the contract was suspended, little rock was encountered. Rock for road metal was obtained from the immediate vicinity and was crushed by hand or by the one rock-crusher available. This was moved along as construction advanced.

Culverts on the whole consisted of corrugated iron pipe brought in from the United States. Because of the difficulties of transportation, the length of sections was limited to what a mule could manage on the steep mountain trails, or about 6 ft. The minimum diameter of

pipe used was 24 in. Where there was need, pipes were laid in batteries of two and three. The larger boxes had sides and bottoms of cement masonry and concrete tops. Too much stress cannot be laid on the necessity of accurate studies of drainage areas in the tropics. When the rainy season lasts eight months, it means that after the first month the ground is thoroughly saturated and

CONSTRUCTION CAMP AT LA MARIANA, ON THE MORTIÑO HIGHWAY, COLOMBIA

all rainfall thereafter must be considered as runoff. When the rain falls at the rate of four inches an hour, dry gullies become raging torrents in a few minutes, and unless the culverts are adequately designed there will be many a bad day trying to work up an explanation as to "why the fill went out."

Experience has shown that one of the most expensive features of road-building in these regions is masonry walls. Hence it becomes a problem of locating and relocating until all walls except those absolutely required are eliminated. But where the mountains go up on one side at an angle often approaching the vertical and down the same way on the other, and where the country is broken up like a crazy quilt, there is often no alternative. On the Carretera-al-Mar this problem was considerably more difficult than on the Mortiño Highway.

Since cement was prohibitive in cost in Colombia in 1927–1930, averaging about $14 per bbl, few walls were built of concrete and then only those for which nothing else would do. Walls were generally of dry masonry. Two such attained the height of 43 ft and were exceedingly well built. Many excellent masons were found among the Colombians, and a considerable number were developed under the guidance of American engineers. However, rigid inspection was necessary for walls; when the engineers' backs were turned they were often placed with shovels. In fact the practice was thought to be quite the thing by the masons as long as large stones showed in front and back.

SPECIFICATIONS FOR CARRETERA-AL-MAR

Since specifications for the Carretera-al-Mar and the Bucaramanga-Mortiño Highway were very much alike, only those for the former will be given:

Right of way outside of towns	20 m (65 ft 7 in.)
Width of road, including shoulders	8 m (26 ft 3 in.)
Width of paved road	5 m (16 ft 5 in.)
Thickness of water-bound macadam paving	20 cm (8 in.)
Maximum grade of road	5 per cent
Spirals provided on curves with radii of	From 38.65 m to 143 m (126 ft 10 in. to 469 ft)
Super-elevation provided on curves with radii of	From 38.65 m to 250 m (126 ft 10 in. to 820 ft)
Minimum radius of curves in open country (10 deg)	114.74 m (573.69)
Minimum radius of curves in hilly country (30 deg)	38.64 m (193.19 ft)
Sight distance on horizontal and vertical curves	60 m (196 ft 9 in.)
Vertical curves	Parabolic
Minimum length of curve provided:	
When the algebraic difference between grades, in percentage, is less than 6	40 m (131 ft 2 in.)
When the algebraic difference between grades, in percentage, is greater than 6	80 m (262 ft 5 in.)
Consecutive curves in same direction may be compounded or may be separated by minimum tangent of:	
In hilly country	50 m (164 ft)
In open country	100 m (328 ft 1 in.)
Consecutive curves in opposite directions, to allow for super-elevation, are separated by minimum tangent of	15 m (49 ft 2 in.)

First a reconnaissance was made, and then a preliminary survey. This in turn was followed by the final location survey. The line was staked out on 20-m (65-ft 7-in.) stations and tied into the preliminary line at 5-km (3.1-mile) intervals. All points of curvature, of tangency, and of intersection, were referenced—and here let me add that at a later date when I had to relocate some 19 miles of the road, these reference hubs were most useful.

Topography was taken on 20-m (65-ft 7-in.) stations and far enough up- and downhill to cover all contingencies such as slides and claims against the road for cast off. Contours were plotted at 1-in. intervals on cross section

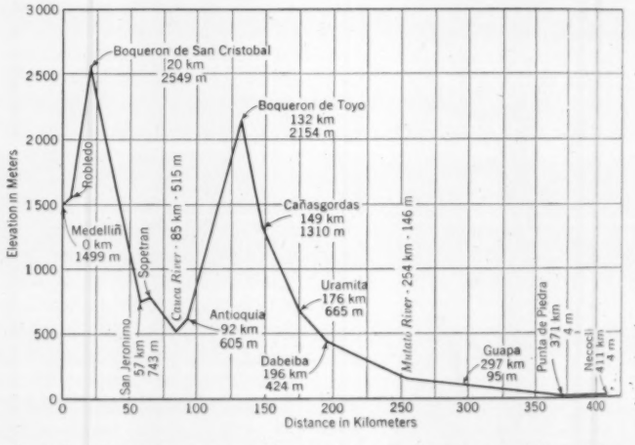


FIG. 3. PROFILE OF THE CARRETERA-AL-MAR, FROM MEDELLÍN

paper, and quantities for earth and rock were taken off after the road section had been superimposed. Besides taking regular sections, topographers were required to note the character of the soil, rock, and vegetation, and sources of surfacing material in streams, gravel beds, and quarries. Sand being scarce, especial care was taken to note all such deposits wherever encountered. The streams crossed were followed up for some distance, and a careful estimate was made of their drainage areas.

It will be well to call attention here to the practice of locating prominent landmarks while making surveys in the countries of South America. Since maps as a rule are

poor, the location of such landmarks will help the cartographer. This practice was begun while I was engaged on highway location for the Republic of El Salvador. It provided considerable knowledge of the geography of even that small and well-populated country.

LIVING CONDITIONS AND PERSONNEL

Those engineers and their wives who contemplate going to Colombia or other Latin-American countries must be warned that it is more economical to live on the products of the country than on canned goods. The price of canned food is prohibitive; it can only be afforded by the very affluent. Some idea of its cost may be had from the following items taken from a price list issued by the leading grocer in Medellín in the spring of 1928:

Cream of wheat, in packages	$6.60 per doz
Olives, 1/2-pt size	8.00 per doz
Asparagus tips	9.60 per doz
Ham and bacon, especially packed	0.90 per lb
Currants, 1-lb cans	14.00 per doz
Baking powder, 12-oz size	10.80 per doz
Cheese, 1-lb tins	14.00 per doz
Tomatoes, No. 2 cans	8.40 per doz
Butter, 1-lb tins	15.50 per doz
Evaporated milk, 14-oz tins	6.60 per doz

American brands of cigarettes sold for from 40 to 60 cents a package, depending entirely on the condition of the Magdalena River.

The engineering personnel was made up of 25 per cent Americans and 75 per cent Colombians. On both projects, sections of 20 to 30 km (12.4 to 18.6 miles) were established with a division engineer in charge. He generally had an assistant and from three to five engineers, usually Colombians, as resident engineers with residencies of from 5 to 10 km (3.1 to 6.2 miles). In the beginning, Americans acted as resident engineers and had Colombian assistants, but when the latter proved their worth they were assigned to residencies.

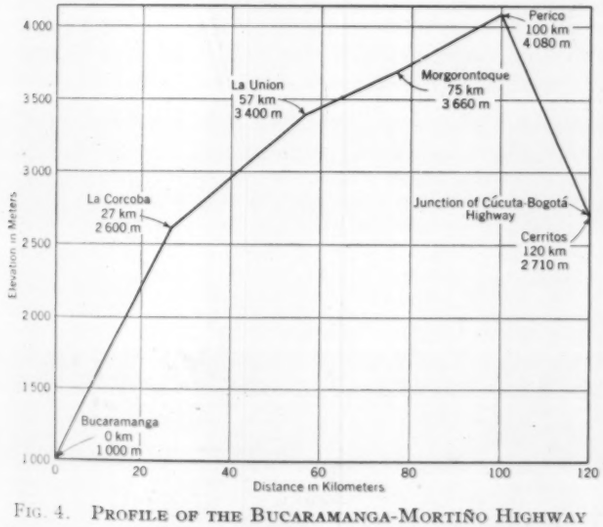


FIG. 4. PROFILE OF THE BUCARAMANGA-MORTIÑO HIGHWAY

Field working hours for the administration forces were from 6 a.m. to 5 p.m., and office hours were from 7 to 5. Laborers on contracts of their own or working for others generally worked from sunrise to sunset six days a week. Sunday was and is religiously reserved, as are the numerous church and state holidays.

Life in camp was what one made it. The camps were generally from one to four days from Medellín or Bucaramanga by mule. Hence, these metropolises were not visited very often. Mail day was always enough of an event to warrant dropping everything in hand, if one happened to be in camp, or to delay dinner, if one had come in off the line. Two- and sometimes three-month-old newspapers were read with an enthusiasm that would have done credit to a New Yorker reading an extra.

TYPICAL SECTION OF THE CARRETERA-AL-MAR
Showing Slide and Almost Continuous Stretch of Retaining Walls

ROUTE OF PROJECTED PAN-AMERICAN HIGHWAY

Of considerable current interest is the projected Pan-American Highway. Coming down through the town of Chepo in Panama, the route must of necessity follow the west coast of the Cordilleras in Colombia to Buenaventura or cross over into the valley of the Rio Atrato through the towns of Pavorondocito and Cañasgordas into the valley of the Cauca to the city of Antioquia. This latter route would seem to be the logical one, for at Antioquia one branch of the broad would go to Medellín while the main section would continue up the Cauca valley to Cali and from there to Bogotá. In this "road-starved" country, it would never be feasible to pass by the larger cities.

Often the question has been raised as to the economic value of various types of surfacing for undeveloped regions in South America. For a country as sparsely settled as Colombia, the chief need in most cases can be met by a suitable bench properly graded and drained. When a better road is required, this bench can be improved by widening, lengthening the sight distance, and reducing grades—work that can be carried on while the road is in use. Without doubt it would be politically to the advantage of the republic to join the larger cities by modern concrete highways, but from other points of view second- or third-class roads will more than suffice until the country is ready to pay for better surfacing. Proper location of the bench at the outset, with the idea of future improvement as the need arises, will go far to "sell" roads to the South American republics.

The chief engineer on the Carretera-al-Mar was J. H. Caton, M. Am. Soc. C.E., who was also in charge of the location and construction of the Mortiño end of the Bucaramanga-Mortiño Highway, on which A. L. Ladd was chief engineer. E. W. Wilson, M. Am. Soc. C.E., was general manager for R. W. Hebard and Company, Inc., contractors on the Carretera, and E. A. Probst held a similar position for Winston Brothers Company, contractors on the Mortiño Highway. I was in charge of the relocation of 19 miles and the construction of 7 miles on the Carretera, and on the location and construction of 12.4 miles of the Mortiño Highway.

ENGINEERS' NOTEBOOK

From everyday experience engineers gather a store of knowledge on which they depend for growth as individuals and as a profession. This department, designed to contain practical or ingenious suggestions from engineers both young and old, should prove helpful in the solution of many troublesome problems.

Picturesque Stone Bridge Saved by Iron Lining

By JOHN T. PURVIS
COUNTY COMMISSIONER, DECATUR COUNTY, IND.

BY lining a twin stone arch with corrugated iron plates slightly smaller in size than the original structure, officials of Decatur County, Indiana, not only saved a picturesque stone bridge, but also secured a practically new structure without going to the expense of removing the old arch and building a new one.

Decatur County is underlain with a good quality of hard stone, easily accessible and of a form and composition suitable for building purposes. Naturally, many of the smaller bridges built during the early days of road construction in that county were in the form of stone arches. For the most part, these structures have given a good account of themselves during the 40 or 50 years they have been in service, but as time has passed they have required an increasing amount of maintenance, such as replacing mortar which has weathered and washed from place. In other cases, repairs have consisted of rebuilding some parts of the structure. While these measures answered immediate needs, they only postponed the time when more complete repairs would be necessary.

During the summer of 1934, the condition of a large twin stone arch six miles southeast of Greensburg, in Marion Township, Ind., indicated that it could not be expected to carry traffic safely during the freezing and thawing of another winter. At one time, the cracks in the structure had been pointed; at another time, the railing and a part of the barrel of one of the arches had been replaced. Because such repairs had been of only temporary benefit, the board of commissioners decided that patchwork applied a little at a time was proving more expensive than permanent repairs would be.

The bridge consists of two semicircular arches each having a rise of 10 ft and a span of 20 ft. The springing line of the arch was approximately 4 ft above the hard rock bed of the stream, giving the structure a total waterway area of about 450 sq ft. To replace the arches with a bridge of nearly similar area would have involved an expense of $3,500 approximately, including the cost of removal and disposal of the old structure.

An alternate proposal was to line the stone arches with sectional corrugated iron plates of a similar size and shape, and backfill the space between the metal and the stone arch with wet, lean-mixed grout deposited through a hole cut in the top of the old structure. A careful survey showed that this plan was feasible, and that the cost would be only about 45 per cent that of rebuilding the arches.

CLOSE-UP OF ARCH SHOWING TYPICAL CONDITION OF BARREL

Measurements of the old arches showed that by raising the springing line, metal arches with an inside clear span of 19 ft 3 in. and a rise of 8 ft $5\frac{1}{2}$ in. would ensure a close fit between the old and the new structures. Footings having a minimum width of 10 in., reinforced with $\frac{1}{2}$-in. round bars, on 12-in. centers horizontally and 16-in. centers vertically, were built inside the old arch. The average height of these footings was 4 ft 8 in. To eliminate the expense of excavating into the hard rock of the stream bed, the footings were anchored to the rock foundation by means of 1-in. dowels on 3-ft centers. To ensure a good bond between the footing and the old arch, all mortar and small stones were removed from the face of the masonry arch to a depth of 6 in. A 3-in. standard, channel, set at an angle that would ensure uniform bearing, was placed in the top of the footings as a seat for the metal arches.

HALF OF ARCH PLATES ASSEMBLED AND RAISED INTO PLACE

METAL ARCHES IN PLACE AND BACKFILLED

The metal arches were assembled as follows. First the plates for one side of the arch were assembled on the stream bed and all bolts were tightened. Then this assembly was raised into place. Once one side of the arch was in place, it was securely propped and the other side was assembled and similarly raised. The two halves of the arch were then bolted together.

After both arches were completely assembled and in place, the space between the new metal and the old stone at each end was tightly sealed for a distance of 12 in. from the face by small stones and a stiff, rich-mixed cement mortar. Care was taken to trowel the face to a smooth, uniform surface. Grout composed of one part cement to ten parts sand and fine gravel was then mixed, using sufficient water so that the pressure of its own weight would force the grout into the openings in the face of the stone arch and completely fill the space between the stone and the metal arch. The grout was introduced through a hole cut through the roadbed and the top of the stone arch.

With the exception of placing the grout backfill, all work was done below the level of the roadway. It was therefore unnecessary to interfere with traffic except during the comparatively short time that the grout backfill was being placed. Had an entirely new structure been built, it would have been necessary to construct a detour or to route traffic over an existing one 5 miles long.

The Decatur County Board of Commissioners, which authorized the making of this improvement, is composed of Ray Miers, Carl Swift, and John T. Purvis. The project was completed under the direction of Mr. Purvis.

Diagrams for Designing Reinforced Concrete Columns

By F. T. MAVIS, ASSOC. M. AM. SOC. C.E.,
and O. J. BALDWIN, JUN. AM. SOC. C.E.

RESPECTIVELY ASSOCIATE DIRECTOR IN CHARGE OF LABORATORY, IOWA INSTITUTE OF HYDRAULIC RESEARCH, AND ACTING HEAD OF DEPARTMENT OF MECHANICS AND HYDRAULICS; AND INSTRUCTOR IN ENGINEERING DRAWING, STATE UNIVERSITY OF IOWA, IOWA CITY.

USUALLY the design of reinforced concrete members under working loads is based on the following assumptions:

1. Both the concrete and steel obey Hooke's law, that is, the unit stress is directly proportional to the unit deformation. Furthermore, $E_s = nE_c$.
2. There is perfect bond between steel and concrete.
3. Concrete is not effective in resisting tension.
4. Any cross section of a member that is plane before the member is stressed is also plane after the member is stressed.

Having accepted these assumptions, it can be shown that the maximum stress, f_{max}, in the concrete of a member subjected to direct stress and bending is expressed by the following equation:

$$f_{max} = \frac{P}{A'} + \frac{M'c'}{I'} \quad . \quad . \quad . \quad . \quad . \quad . \quad [1]$$

in which

P = the axial component of the applied load
A' = the effective cross-sectional area of the member, that is, the area of concrete which is in compression plus n times the area of longitudinal bars
M' = the bending moment about the axis passing through the centroid of the effective area A'
c' = the distance from this centroidal axis to the outermost fiber which is effective in resisting compressive stresses
I' = moment of inertia of the effective area, A', about its centroidal axis

Equation 1 may also be written as follows:

$$f_{max} = \frac{P + \frac{M'}{k'}}{A'} = P\,\frac{1 + \frac{e'}{k'}}{A'} \quad . \quad . \quad . \quad . \quad [2]$$

in which

k' = the bending factor, $\frac{I'}{A'c'}$

e' = the eccentricity of the resultant axial load P, measured from the centroidal axis of the effective section.

Equations 1 and 2 are fundamental but they are not in the form most convenient for use by the designer. The position of the neutral axis (the axis of unstressed fibers) must be known or assumed before the effective section can be determined. The position of the neutral axis, however, depends (1) on the eccentricity of the resultant load, (2) on the amount and location of the reinforcement, and (3) on the relative stiffness of the concrete and steel. The general relationship of these variables is represented by a cubic equation, as shown by Messrs. Taylor, Thompson, and Smulski in *Concrete Plain and Reinforced*, Vol. 2, Chapter 2 (1928).

By a simple transformation of variables it is possible to establish an equation in terms of the gross equivalent area of concrete, and bending moments or eccentricities referred to the geometrical axis of the cross section. Let

M = bending moment about an axis coinciding with the geometrical axis of the column cross section
k = bending factor based on the gross transformed section of the member
$A = A_c + (n - 1)\,A_s$
= the gross transformed area of the member
e = the eccentricity of the resultant load P measured from the geometrical axis of the cross section

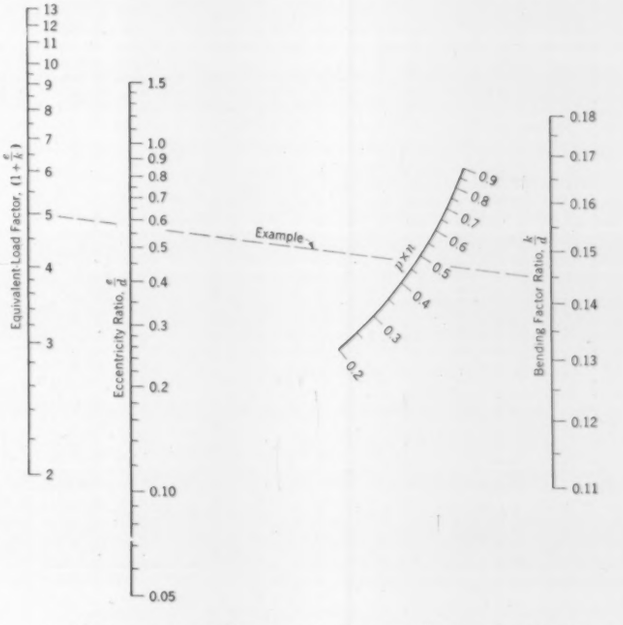


FIG. 1. DIAGRAM FOR DESIGNING ROUND CONCRETE COLUMNS WITH ECCENTRIC LOADS

Then $$f_{max} = \frac{P + \frac{M}{k}}{A} = P\frac{1 + \frac{e}{k}}{A} \quad . \quad . \quad . \quad . \quad . \quad [3]$$

This equation gives values for maximum concrete stress identical with those obtained from Equation 2 if

$$\frac{e}{k} = \left[\left(1 + \frac{e'}{k'}\right)\left(\frac{A}{A'}\right)\right] - 1 \quad . \quad . \quad . \quad . \quad [4]$$

Equations of the type of Equation 3 were suggested by Hardy Cross, M. Am. Soc. C.E., in an article, "Design of Reinforced Concrete Columns Subject to Flexure," published in the *Journal of the American Concrete Institute* for December 1929.

The bending factor ratio, $\frac{k}{d}$ (d being the diameter of the column core), is a function of the eccentricity ratio, $\frac{e}{d}$, the longitudinal reinforcement ratio, p, and the relative stiffness of steel and concrete, $n = \frac{E_s}{E_c}$. The relation between these factors for round columns is shown in Fig. 1. Any straight line which intersects the scales $\frac{e}{d}$, pn, and $\frac{k}{d}$, connects corresponding values of these variables which satisfy the conditions imposed by equilibrium and by the original assumptions. Values of $\frac{e}{k}$ in Equation 3 can thus readily be obtained from Fig. 1, since $\frac{e}{k} = \frac{e}{d} \div \frac{k}{d}$.

The "equivalent-load factor" is the ratio of a nominal axial load, P_{eq}, to an eccentric load, P, on a given column for the condition that P and P_{eq} give rise to the same maximum fiber stresses in the column. If a part of the cross section is in tension, the "equivalent-load factor" $\left(1 + \frac{e}{k}\right)$ is greater than 2.0, and its value can be read directly on the left-hand scale in Fig. 1. In many cases the equivalent-load factor can be determined closely enough by the formula, $1 + \frac{e}{k} = 1 + 7\frac{e}{d}$.

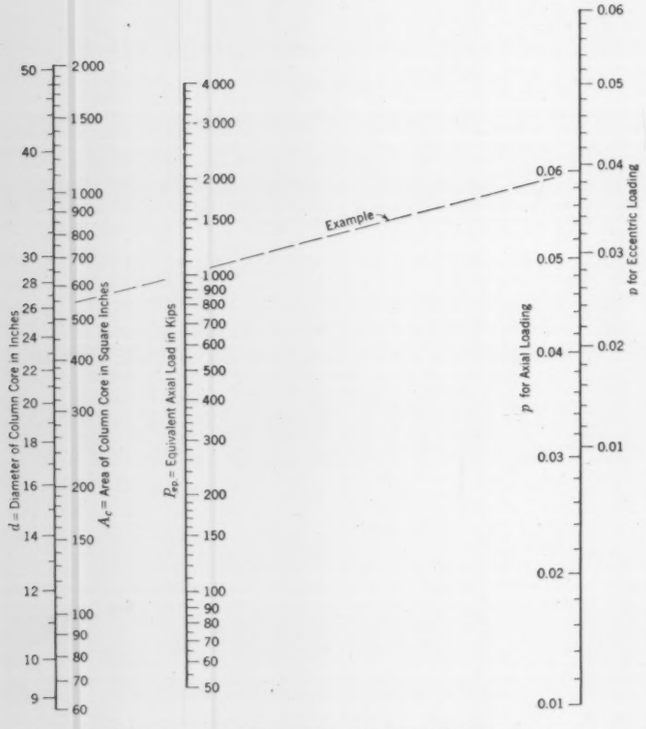

d = Diameter of Column Core in Inches
A_c = Area of Column Core in Square Inches
P_eq = Equivalent Axial Load in Kips
p for Axial Loading
p for Eccentric Loading
Example

FIG. 2. DIAGRAM FOR DESIGNING ROUND SPIRAL COLUMNS

The Joint Standard Building Code of 1928 permits maximum unit stresses, f_{max}, in the concrete of spiral columns as follows.

For columns axially loaded [Sec. 1103(a)],

$$f_{max} = 300 + (0.10 + 4p)f'_c \quad . \quad . \quad . \quad . \quad . \quad [5]$$

For columns in bending [Sec. 1105(c)],

$$f_{max} = 300 + (0.10 + 4p)\,f'_c + 0.15f'_c \quad . \quad . \quad . \quad [6]$$

in which f'_c = minimum ultimate strength of concrete at 28 days

p = ratio of longitudinal reinforcement

Substitution of Equations 5 and 6 in Equation 3 gives the "equivalent axial load," $P_{eq} = P\left(1 + \frac{e}{k}\right)$, for columns axially loaded, as follows:

$$P_{eq} = A_c[1 + (n - 1)p][300 + (0.10 + 4p)\,f'_c] \quad . \quad . \quad [7]$$

and for columns in bending

$$P_{eq} = A_c[1 + (n - 1)p][300 + (0.25 + 4p)f'_c] \quad . \quad . \quad . \quad [8]$$

Fig. 2 is a nomographic chart for solving Equations 7 and 8 for round columns using a value of 2,500 lb per sq in. for f'_c and a value of 12 for n. Any straight line intersecting the three scales defines the corresponding value of A_c (and the diameter of the column), of P_{eq}, and of p, which satisfy these equations. The graduations of the p scale show the longitudinal reinforcement ratio for axial loading on the left and for eccentric loading on the right of the p-line.

As an example showing the use of the diagrams, consider the design of a round spiral concrete column to resist a load of 200 kips and a bending moment of 3,000 kip-in. using f'_c equal to 2,500 lb per sq in. and n equal to 12.

The eccentricity is $e = \frac{3{,}000}{200} = 15$ in. Try a column 26 in. in diameter. Then $\frac{e}{d} = \frac{15}{26} = 0.577$. Try $p = 0.04$, or $pn = 0.04 \times 12 = 0.48$. Using Fig. 1, lay a straight edge through the value of 0.48 for pn and through the value of 0.577 for $\frac{e}{d}$. It will intersect the bending factor scale $\left(\frac{k}{d}\right)$ at 0.144 and the equivalent-load factor scale $\left(1 + \frac{e}{k}\right)$ at 5.0. Accordingly, the equivalent axial load, P_{eq}, which would give rise to the same maximum fiber stresses as the 200 kip load with an eccentricity of 15 in. would be

$$P_{eq} = 5.0 \times 200 = 1{,}000 \text{ kips.}$$

Using Fig. 2, note that a column 26 in. in diameter (having a core area of 530 sq in.), supporting an equivalent axial load of 1,000 kips, requires a reinforcement ratio $p = 0.0395$ for eccentric loading. This value of p agrees with the value assumed in the foregoing paragraph. The required area of longitudinal reinforcement is $A_s = 0.0395 \times 530 = 21.0$ sq in. Further details of proportioning are simplified by the use of tables of bar sizes.

OUR READERS SAY—

In Comment on Papers, Society Affairs, and Related Professional Interests

Slum Clearance in St. Paul

To the Editor: I should like to comment on Mr. Deutsch's article on restoring blighted areas in the large cities, in the March issue. The Real Property Inventory, made by the U. S. Department of Commerce in 64 cities, discloses that 17 per cent of our houses are structurally unsound. I believe that these houses should be demolished and replaced with similar structures in order to maintain a stable neighborhood. The solution of the slum clearance problem does not lie in building tenements that will produce speculation and upset the tax structure of a district.

The City of St. Paul, Minn., which has a population of 300,000, has submitted to the government a plan to rehabilitate an old residential district laid out in 1857. The houses are of frame construction, and 479 structures house 560 families. Some attempt has been made to repair and keep up about 50 per cent of these structures; the rest are unfit for occupancy, although all are in use. This area, which comprises 131 acres, is three blocks from the State Capitol Building and within walking distance of the city market. Land values in the district are natural, that is, real estate speculators abandoned the district prior to 1900 because they could no longer advance the values they had built up, and its value today averages 22 cents per square foot for land and buildings.

Since St. Paul has plenty of land, it does not need to build tenements or row-houses for the low income group. All over the city there are vacant lots that are provided with all the utilities. There are also blighted areas in a fringe about the business district, which will always be used for residence. Thus the problem involves: (1) selecting a blighted area, the rehabilitation of which is most needed; (2) conserving the utilities and municipal developments already built and paid for; (3) replanning the site to make the best use of the land; (4) designing a simple adequate shelter for a family of low income—something that no architect has ever done; and (5) housing those evicted during construction and selecting new tenants.

Planning four-story walk-ups may bring the designer a larger commission than preparing plans for small houses, but this should not be one of the considerations. When Sir Raymond Unwin viewed Milwaukee's proposed slum clearance project he said, "If you replace these houses with four-story, brick walk-ups, you will have a worse slum here in ten years than you have now."

The problem of rehabilitation of blighted areas in the near bankrupt cities of the United States is the greatest economic problem that has ever confronted them. Inflated land values and architects' commissions are being given too much consideration in solving the problem. I do not believe that replacing old houses with a block of four-story walk-ups with a so-called park in the center is the solution, at least in our western cities.

In the past, as Mr. Deutsch has pointed out, immigration has had an important influence on the development of housing in the larger eastern cities. This influence no longer obtains, nor is it likely to be an influence again.

The structures designed for St. Paul's housing project are two, three, and four-family buildings surrounded by yards. There is a coverage of 9½ families per acre. The design is the prototype of the old New England farmhouse, the Minnesota farmhouses of the present day, or the section houses built in North Dakota and Montana in the early nineties by railroad companies to house section foremen and their families. They consist of a large living-room and two, three, or four bedrooms, modernized with a bathroom, central heating plant, and if desired a small kitchen. It is possible to build three-family apartments that will be self-liquidating, with the government grant of 30 per cent, 3 per cent interest, and a 44-year period of amortization, during which two apartments will bring $17.60 each per month and one apartment, $12.50 per month on the site selected.

Individually Owned Homes in St. Paul Housing Project

George H. Herrold, M. Am. Soc. C.E.
Managing Director and Engineer
The St. Paul City Planning Board

St. Paul, Minn.
May 1, 1935

Sewage Treatment in Cleveland

To the Editor: I read Mr. Eddy's article on the "Pretreatment of Sewage for Grease Removal," in the March issue, with much interest, as this problem is one to which we have given a great deal of study in connection with our sanitary engineering work in Cleveland. The problem is particularly acute at our Westerly plant, where approximately 15 per cent of the flow is from the stockyards district.

During 1933 there were two grease catchers in operation at this plant, treating from 5 to 20 mgd. One of these tanks was of the Imhoff type; the other was similar in design except for the inside baffling arrangement. Air was supplied to the influent channels and tanks at a rate of 0.023 cu ft per gal. This rate was sufficient to prevent the deposit of sludge in the tank and, at the same time, to provide active aeration in the channels and flowing-through compartments.

The largest of the grease particles were retained in the grease catchers. However, the finer particles did not float until the grease reached the Imhoff or main settling tanks of the plant where it was skimmed from the surface. It should be borne in mind that a great deal of grease in sewage, as determined in the ordinary ether soluble method, is not recoverable in the ordinary course of aeration and subsequent flotation. In other words, a substantial part will pass through a settling tank in the effluent. As Mr. Eddy points out, there is also a substantial part which attaches itself to

sludge particles and settles as sludge. A study of the ether soluble matter at the Westerly Sewage Treatment Works for two months in 1933, showed the following results:

Total ether soluble matter in raw sewage	70 ppm
Total ether soluble matter in settled sewage	46 ppm
Removal	24 ppm (or 34 per cent)

The 24 ppm that were removed were distributed as follows:

Skimmings from the Imhoff tanks	10.5 ppm
Skimmings from oil and grease catchers	2.5 ppm
Attached to sludge particles	11.0 ppm
Total	24.0 ppm

A similar study made on 28 weekly composites, from January to June 1934, when the grease catchers were not in operation, showed a total grease in the raw sewage of 66.2 ppm, and in the settled sewage of 46 ppm, with a removal of 20.2 ppm. In this period the skimmings from the Imhoff tanks amounted to 588,500 lb of dry grease solids. The grease removed as skimmings from the Imhoff tanks had an average moisture content of about 58 per cent, a volatile matter content of 96 per cent, and an ether soluble matter content of about 85 per cent.

I regard the 33 per cent removal (25 parts of 75 parts) found at the Westerly plant as rather low. However, there is in every sewage a certain amount of grease, depending on the characteristics, which cannot be removed and must therefore pass out with the effluent. With proper aeration and with two or three minutes detention in a properly designed and operated grease catcher, followed by a quiescent period in a settling tank, a greater percentage of the grease will become skimmable and recoverable.

As Mr. Eddy aptly states, "The design of skimming tanks to handle municipal sewage has not yet been crystallized." I am of the opinion that air applied to the sewage soon after arrival at the plant, will assist in preparing the grease for subsequent removal. However, time is an important element, and it would seem that more is to be gained by a study of methods for the removal of grease from preliminary settling tanks, than by the construction of elaborate grease catchers of short detention. Where oil is more predominant than grease, the small preliminary tank appears to be of more value.

GEORGE B. GASCOIGNE, M. Am. Soc. C.E.
Consulting Sanitary Engineer

Cleveland, Ohio
April 18, 1935

Problem of Grease in Sewage Disposal

TO THE EDITOR: The appearance of the article on "The Pretreatment of Sewage for Grease Removal," by Harrison P. Eddy, Jr., M. Am. Soc. C.E., in the March number of CIVIL ENGINEERING, is most timely. Even before the days of oiled roads and oil burners, grease in sewage caused trouble. For instance, wool-scouring waste in sewage made intermittent sand filters inoperable and even affected the efficiency of trickling filters. Likewise, tannery waste, with its mixture of lime-soaps, petroleum oil, and animal fats, is a well-known nuisance, not only in treatment works but also where beaches are befouled by grease balls derived from the discharge of industrial wastes with sewage, as in the harbor of Beverly, Mass.

The problem as well as current methods for its solution has been well presented by Mr. Eddy. In sewage treatment, there are three kinds of grease that must be considered: (1) insoluble, unsaponifiable, mineral oils, such as paraffin or kerosene; (2) wax-like greases, such as the lanolin in wool, which form emulsions with sewage; and (3) animal and vegetable fats, such as tallow or cocoanut oil, which are usually present in the form of soap.

The thick mineral oils are readily separated from the sewage by flotation, while the soaps are an integral part of it. In this connection, the results of the determination of fats in sewage from 16 cities are particularly valuable, although the average percentage of fat in the suspended matter—28 per cent of 53 ppm—may seem high. However, in view of the fact that a large part of the fats may be in the form of soap, this is not surprising.

Although animal and vegetable fats are contained in domestic sewage, the amount of mineral oil discharged from domestic garages is probably minimal. This is not the case with the discharges from public garages and filling stations. However, most of the trouble caused by such discharges may be prevented by stopping the entrance of wastes from garages, filling stations, and certain factories. It is a well-known fact that grease traps and grease-recovery plants are very efficient, if they are taken care of.

The village of Canajoharie, N.Y., arranges for the regular collection of these materials at the sewage treatment works. Nearby is the municipal incinerator where there is a special oil separator, the separated oil being used for auxiliary fuel or on the roads.

For the removal of emulsified grease, such as that in wool-scouring waste, the use of centrifugals is worthy of consideration. These machines, while not so efficient as the acid-cracking process, will remove from 40 to 60 per cent of the suspended fats and all of the fats which would rise to the surface of tanks. They will also remove the settleable solids. Mr. Eddy has well described the devices in common use. It might be added that the use of circular centrifugal skimming tanks with tangential inlets at the bottom and skimming overflows at the center and top are often efficient for separating grease from sewage.

ROBERT SPURR WESTON, M. Am. Soc. C.E.
Weston and Sampson, Consulting Engineers

Boston, Mass.
April 20, 1935

Marine Borers Increasingly Active

TO THE EDITOR: In connection with the abstract of Mr. Shepherd's article in the March issue of CIVIL ENGINEERING, I should like to comment on one or two high lights in the present marine piling investigation in New England. During the last nine months considerable progress has been made, and records of the past history and present condition of some 300 wharves along the New England coast are now available. The date of building, material used, treatment, if any, and other pertinent facts are included in these records.

Examinations by divers have been made of some of the important structures, particularly in Boston, Plymouth, New Bedford, and Weymouth. In Boston, about one-tenth of the marine structures have been examined by this method. Measurements of the piles in the various docks, together with notes on the present condition of the piles, have been recorded for future reference. Also, diagrams showing the exact position and condition of over 15,000 piles in Boston Harbor have been made. This at least provides actual data on which the rate of deterioration can be based.

In the past there have been a number of excellent investigations into the activity of marine borers. The most important was that of the National Research Council, made some ten years ago under the direction of William G. Atwood, M. Am. Soc. C.E. The San Francisco investigations have added much to present knowledge of the problem, and the Australian report by Dr. Tom Iredale also ranks as a major investigation. In all past investigations, however, a tremendous amount of work has been crowded into a few months, important discoveries and information have been hurriedly published, and then, because of lack of funds, the investigations have ended abruptly.

Furthermore, no investigation has been soundly financed. Thus investigators have rushed the work in order to accomplish as much as possible before the funds gave out. This is unfortunate because the problem of marine borers needs continued and consecutive study. It requires years to demonstrate the value of service records and exposure tests of materials and treatments, and the ideal investigation would be organized to function over a period of years. In such an enduring, although less intensive, study the cost would be but little more. It would also be a distinct advantage to have the cost distributed over a considerable period. The returns from such an investigation would pay for the expenditure. So far the New England investigation has cost about $5,000, and there is not the slightest doubt but that the immediate return on this investment, in Boston Harbor alone, has exceeded that amount many times over. There is a strong probability that a long-time study of the marine structures along the New England Coast will be undertaken.

Another important factor in the investigation of marine borers is that of pollution. There is considerable evidence that pollution in tidal waters is a deterrent to the borers. In several harbors, which have recently been partially or entirely cleaned of pollution,

there have been very heavy losses due to the invasion of Limnoria and Teredo. Lynn Harbor affords an excellent example of such a situation.

However, no one would advocate maintaining foul harbor conditions as a preventative. So obviously the solution is to build structures that will resist attack when harbor conditions invite Teredo and Limnoria invasion. This is a factor that has been found of considerable importance in New England waters. It is interesting to speculate as to what may be expected in Newark Bay at the present time. Also, what will happen in New York Harbor when the present project for cleaning the harbor is completed? Even now several organisms which are known to thrive under conditions favorable for marine borers, are becoming firmly established in Newark Bay.

WILLIAM F. CLAPP
Consulting Biologist, New England Committee on Marine Pile Investigation

Duxbury, Mass.
April 16, 1935

New York's Progress in Sewage Disposal

TO THE EDITOR: As shown in Mr. Gould's article in the March issue, the problem of sewage disposal in New York is complicated. Each of the 38 projects proposed for the system must be considered in the light of whether it will meet local needs and whether it will fit into a comprehensive scheme for the city as a whole.

Numerous investigations of the problem of sewage treatment have been made in the past 50 years. These include the report of the New York Bay Pollution Commission made in 1903 and the very exhaustive work done by the Metropolitan Sewerage Commission in the years following, up to 1924. The importance and value of that work are evident in the wide use of the float results. Other investigations contributing to the solution of the problem include the Black and Phelps studies, involving early work in oxygen demand; the studies made by the Passaic Valley Sewage Commission; the long-continued studies of the Board of Estimate; the report of the Jamaica Bay Improvement Commission; the supplementary work on float tests done by the U. S. Corps of Engineers; the recent work of the late George W. Fuller, M. Am. Soc. C.E., on the Wards Island project; and of course now the undertakings of the Tri-State Commission and the Department of Sanitation.

I am interested in comparing the development of the New York system of sewage treatment and disposal with that in the Chicago area. Both of them apparently got under way at about the same time. Some 50 years ago the late Rudolph Hering, M. Am. Soc. C.E., was engaged by the city of Chicago to report on the problem. He recommended the main drainage canal, which was constructed during the next 10 or 15 years. Then followed the work of Wisner and Pearse, which began in 1909 and culminated in the years from 1911 to 1914 in their comprehensive general scheme of sewage disposal for the city. Their scheme included the North Side, West Side, Southwest Side, and Calumet projects, as comprising the backbone of the sewage disposal system. In addition to these four major projects, the city of Chicago also has several minor ones.

The work done in Chicago and the experimental efforts growing out of it were summed up by the Technical Board of Review and published in unusually complete form in 1926 or 1927. It is interesting, also, to note the findings of the Metropolitan Sewerage Commission, which were published in 1914. In addition to making a detailed study of the sewage disposal and pollution problems of the city, they investigated tidal phenomena, prepared comprehensive general schemes for works and policies, proposed a standard of cleanliness, recommended that the projects be carried out by a special commission, and suggested the appointment of an interstate supervisory commission of New York and New Jersey. The special commission has taken the form of the Department of Sanitation, and the interstate supervisory commission is the Tri-State Commission, which includes Connecticut, New York, and New Jersey.

In 1931, on the basis of the findings of the Metropolitan Sewage Commission, Mr. Gould prepared what is known as a general plan for sewage disposal for New York. The magnitude of the project is indicated by the costs involved, which range from $159,000,000 for somewhat limited treatment to $378,000,000 for more complete treatment.

The two major problems confronting New York in its treatment of sewage are the elimination of the dense and growing nuisances in certain localities and the avoidance of over-pollution of the major bodies of water. The Wards Island plant now under construction will help in the solution of both problems by protecting the Harlem and upper East rivers from gross pollution and reducing the load on the general system. The works recently designed for the Coney Island project are more particularly for the relief of Jamaica Bay and the protection of the Coney Island and adjacent beaches.

SAMUEL A. GREELEY, M. Am. Soc. C.E.
Greeley and Hansen, Hydraulic and Sanitary Engineers

Chicago, Ill.
April 16, 1935

Studies of Sewage Disposal in New York

TO THE EDITOR: There are certain points in Mr. Gould's article, in the March issue, that I would like to emphasize. Mr. Gould is to be complimented on his cautious, experimental approach to the whole problem of pollution in New York Harbor. Despite the long years of study that have been given to the problem, we have not yet passed the danger of a hysterical or sentimental outburst, as there has been ample opportunity to observe during the past few years. These matters cannot be disposed of on a summer afternoon by a newspaper reporter and a commercial laboratory. It is a significant fact that, out of the liberal appropriations which this great city makes for health, hospitalization, education, recreation, and all the things which make life more worth living, less than 1 per cent is being devoted to the correction of the condition of our harbor waters.

Mr. Gould's discussion of standards is also illuminating and might well be amplified. We have a right to look forward to more stringent regulations and higher standards of purity for these waters, for the reason that expediency is a controlling factor in such situations. With a continued rise in sanitary and esthetic standards and a decrease in the cost of treatment of polluted waters, the rule of expediency leads inevitably toward improved conditions. It is only because of the kind of investigative work that has been done and is being done by the members of the Sanitary Engineering Division that we are today in a position to say, "These remedial measures will cost just so much," and to decide that the benefits justify the expenditures.

There is much of interest in Mr. Gould's discussion of the bio-chemical oxygen demand and the general oxygen situation in these waters. It is encouraging that a definite program of investigation, embodying our modern concepts of the chemistry of stream pollution, has been initiated. The recorded excess of bio-chemical oxygen demand over the estimated per capita contribution is higher than can be reasonably attributed to industrial wastes, although careful studies of this relation in both Chicago and Indianapolis show an additional contribution of industrial waste equivalent to about 40 per cent of the contributing population. In any event the difference is sufficient to indicate the primary importance of a thorough and continuous record.

Certainly Mr. Gould is to be congratulated on having adopted a program that takes into account both stream investigation and laboratory research. Such a program should go far toward supplying the basic data necessary before any proper discussion of remedial measures is possible.

EARLE B. PHELPS
Professor of Sanitary Science, College of Physicians and Surgeons, Columbia University

New York, N.Y.
April 15, 1935

Railroad Bridge Across Cape Cod Canal

TO THE EDITOR: In connection with the abstract of Lieutenant Harwood's article on the Cape Cod Canal in the March issue, I should like to comment on the single-track, vertical-lift, railroad bridge, now under construction across the canal at Buzzards Bay. The piers are complete, and steel erection, which was started in March, will be completed in December.

In the design of this structure the firm of McKim, Mead and White was retained as architects. I believe that this is the first instance in which there has been architectural cooperation in improving the appearance of a bridge of this particular type.

Having been employed in an engineering capacity on the design and construction of the original canal and the three bridges over it which are now being replaced by new ones, we realized that large boulders would probably be encountered in most pier excavations. We also knew that the pneumatic piers used for foundations of the old highway bridges had been constructed without difficulty and that the piles driven for the foundations of the existing railroad bridge "drove very hard," many of them being brought to refusal by encountering boulders. We originally designed pneumatic caissons for the main piers of the new railroad bridge but, after due consideration, it was decided to permit the use of open cofferdams, and the low bidder used this method.

VERTICAL-LIFT RAILROAD BRIDGE NOW UNDER CONSTRUCTION ACROSS CAPE COD CANAL AT BUZZARDS BAY

The construction proceeded without difficulty until a depth of about 25 ft in the south main pier and of 20 ft in the north main pier had been reached. At these depths the driving of the steel sheet-piles became difficult, due to the presence of many boulders. Altogether, 327 boulders were excavated. Their average size was $1^3/_4$ cu yd; the largest was 74 cu yd. In spite of the difficulties of driving, work on the south pier was continued in the dry until a depth of 48 ft had been reached. In the north pier a depth of about 31 ft was reached.

At this point, the engineers decided to adopt a pile foundation that would not require excavation to so great a depth. Accordingly, the designs of the main piers were changed to require excavation to a depth of 60 ft, to elevation −55, or 17 ft higher than originally planned. Piles were driven at this elevation and cut off a few feet above it. Then the concrete foundation was built upon the piles and the adjacent supporting ground, thus ensuring a suitable foundation with less delay. The cost to the contractor was also less than it would have been had the excavation been carried down to the originally contemplated depth.

An interesting method of keeping the excavation dry enough to permit excavating the boulders from under the sheet-piles was employed. This called for a rather elaborate system of well-points. Five rings of well-points were installed, each point extending to a depth of 16 ft below the headers. Header pipes 6 in. in diameter were located at elevations 103, 84, 74, and 66, mean sea level being 100. In all, about 350 well-points were used. The topmost ring was placed in an auxiliary cofferdam outside the main cofferdam, the others inside. When the excavation had extended below the ring at elevation 84 this series of points was projected through the sheeting to assist in keeping the water level down in the soil outside the cofferdam. Some of the lower ring of points were retrieved after the pouring of the concrete by placing standard 6-in. pipes around each point; others became jammed in the gravel and were left.

E. L. MACDONALD, M. Am. Soc. C.E.
Associate Engineer, Parsons, Klapp, Brinckerhoff and Douglas

New York, N.Y.
April 25, 1935

Commerce Through the Cape Cod Canal

TO THE EDITOR: Several thoughts come to mind in connection with Lieutenant Harwood's article on the Cape Cod Canal, abstracted in the March issue of CIVIL ENGINEERING. The amount of traffic passing through the canal reached a peak in 1930 so far as the number of ships was concerned. However, except for 1932, both gross and net registered tonnage have steadily increased in recent years. The reasons for the increased use of the canal are as follows: (1) the elimination of tolls undoubtedly attracted a large number of ships; (2) the prejudice of mariners against the canal has been overcome to a great extent; (3) the canal is being maintained to a depth of more than 21 ft at mean low water; and (4) increasing the width of the canal to 170 ft near the Sagamore Bridge early in 1933 facilitated the passage of ships.

More than 80 per cent of the total coastwide trade in and out of the port of Boston passes around or through the Cape Cod Canal. Furthermore, most of the coastwise traffic passing Cape Cod is with the port of Boston. However, there is still a great deal of traffic passing around Cape Cod, which might use the canal. Some of these ships could use the canal at present; others are unable to do so because of its limiting depths.

The increase in traffic through the canal for 1933 was 605 vessels, while the increase in shipping around Cape Cod during the same period was 350 vessels. Of the total increase, 63 per cent went through the canal and 37 per cent went around Cape Cod.

It is unquestionably significant that in 1933, supposedly one of the worst years of the depression, the net registered tonnage passing through the canal was the greatest in its entire history, except for a brief period during the War when submarine scares forced all ships that could do so to use the canal. Also, when it is remembered that the net registered tonnage entering and leaving the port of Boston was likewise at an all-time high in 1933 and that much of this commerce will use the canal as soon as it is improved, the future usefulness of the waterway is seen to be unquestionable.

It is known that the total coastwise cargo in and out of Boston during 1933 was 12,250,000 tons. It is expected that approximately 80 per cent of this will use the canal when adequate improvements have been made. Only 2,805,000 cargo tons were passed through the canal in 1933, leaving 6,995,000 tons that might have gone through. The total costs of all improvements contemplated, including the new bridges, will be about $31,075,000. At 3 per cent, the annual interest charges would be $932,000, which amounts to only 13 cents per cargo ton, or 0.20 cent per ton mile, even on the basis of commerce during a depression year. The saving in distance resulting from the canal is about 65 miles. This means that fuel costs alone for steamers would probably be between $50 and $200, depending on the size of the ship, for the additional distance involved if the canal were not used. For barge tows the saving in fuel effected by use of the canal route would be smaller, but for them the safety provided by that route is of even greater importance.

It is true that a small part of the coastwise tonnage in and out of Boston may never use the canal. However, this loss would probably be more than counterbalanced by coastwise tonnage, particularly coal and petroleum products, to ports north of Boston. Thus, from an economic standpoint, the benefits derived from improving the canal will justify the entire project, including the original investment.

J. A. WOODRUFF,
Brigadier General, U. S. Army

San Francisco, Calif.
May 3, 1935

Sixty-Fifth Annual Convention

Ambassador Hotel, Los Angeles, Calif., July 5–7, 1935.
Program of Sessions, Entertainment, and Trips

Opening Session and General Meeting

WEDNESDAY—July 3, 1935—Morning

8:00–9:30 **Guests of Breakfast Club, Ambassador Hotel**
Members and guests invited. $1.00 per plate.

9:30 **Registration**

10:00 **Sixty-Fifth Annual Convention called to order by**
ALFRED JONES, *Assoc. M. Am. Soc. C.E., County Surveyor, County of Los Angeles,* Los Angeles, Calif.; *President, Los Angeles Section, Am. Soc. C.E.*

10:10 **Address of Welcome**
His Honor, FRANK L. SHAW, *Mayor of the City of Los Angeles.*

Response
ARTHUR S. TUTTLE, *President, American Society of Civil Engineers; Consulting Engineer; New York State Engineer (PWA),* New York, N.Y.

Annual Address
ARTHUR S. TUTTLE, *President, American Society of Civil Engineers.*

11:30 **The Romance of the Ranchos of California**
PALMER CONNER, *Esq., Assistant Secretary, Title Insurance and Trust Company,* Los Angeles, Calif.

12:30 **Business Meeting**

WEDNESDAY—July 3, 1935—Afternoon

2:00 **Physiography of the Los Angeles Metropolitan Area**
A. L. SONDEREGGER, *M. Am. Soc. C.E., Consulting Engineer,* Los Angeles, Calif.

2:30 **Discussion by**
D. A. LANE, *Assoc. M. Am. Soc. C.E., Engineer of Ground Water Development, Bureau of Water Works and Supply,* Los Angeles, Calif.

2:40 **Engineering Contributions to the Development of California**
J. B. LIPPINCOTT, *M. Am. Soc. C.E., Consulting Hydraulic Engineer,* Los Angeles, Calif.

3:10 **Discussion by**
CHARLES T. LEEDS, *M. Am. Soc. C.E., Consulting Engineer,* Los Angeles, Calif.

3:20 **Engineering Outlook for Southern California**
RAYMOND F. GOUDEY, *Assoc. M. Am. Soc. C.E., Sanitary Engineer, Department of Water and Power,* Los Angeles, Calif.

3:50 **Discussion by**
HARRISON P. EDDY, *Past-President, Am. Soc. C.E., Consulting Engineer,* Boston, Mass.

WEDNESDAY—July 3, 1935—Evening

FIESTA ROOM, AMBASSADOR HOTEL

7:00 **Dinner Dance and Entertainment**
Tickets for the dinner and entertainment are $2.50 each.

All-Year Club Photo

ARCHES OF SAN JUAN CAPISTRANO

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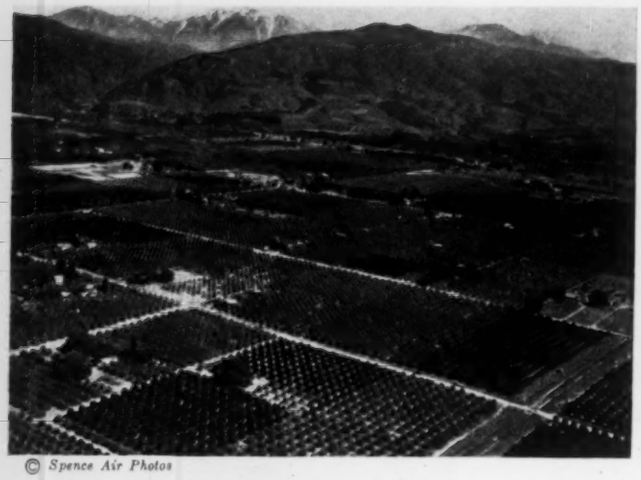
BUSINESS DISTRICT OF LOS ANGELES, LOOKING NORTHWARD

See Table on Page 377 of This Program for Reduced Railway Fare Rates



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IRRIGATED LAND IN THE FOOTHILL DISTRICT
On the Way to the Padua Hills, California

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MORRIS DAM BUILT BY THE CITY OF PASADENA
A Storage Unit on the Colorado River Aqueduct System

One Day Devoted to Sessions of Technical Divisions

THURSDAY—July 4, 1935

HIGHWAY DIVISION

Morning

9:00 Observance of Traffic Control Devices and Regulations

(1) WILLIAM G. ELIOT, 3d, *Esq., Highway Economist, Bureau of Public Roads*, Washington, D.C.

(2) E. B. LEFFERTS, *Esq., Manager, Public Safety Department, Automobile Club of Southern California*, Los Angeles, Calif.

10:20 Discussion

POWER DIVISION

Morning

9:30 Recent Advance in Steam Power Plant Design

THOMAS T. EYRE, *Mem. A.S.M.E., Professor of Mechanical Engineering, University of Southern California*, Los Angeles, Calif.

Discussion by

H. L. DOOLITTLE, *M. Am. Soc. C.E., Chief Designing Engineer, Southern California Edison Company, Ltd.*, Los Angeles, Calif.

R. McC. BEANFIELD, *M. Am. Soc. C.E., Consulting Engineer*, Los Angeles, Calif.

10:40 A Modern Diesel Engine Generating Plant

HOWARD MCCURDY, *Assoc. M. Am. Soc. C.E., City Engineer, City of Vernon*, Los Angeles, Calif.

CITY PLANNING DIVISION

Morning

10:00 Objectives and Progress of State Planning with Special Emphasis Upon the California State Planning Board

L. DEMING TILTON, *Esq., Director, California State Planning Board*, Los Angeles, Calif.

10:30 Discussion by

GORDON WHITNALL, *Esq., Member, California State Planning Board*, Los Angeles, Calif.

HARRY BERGH, *Esq., Planning Draftsman, Regional Planning Commission*, Los Angeles, Calif.

11:00 Use of Plans and Planning in Programming of Emergency Public Works

WILLIAM J. FOX, *Assoc. M. Am. Soc. C.E., Chief Engineer, Los Angeles County Regional Planning Commission*, Los Angeles, Calif.

11:30 Discussion by

A. D. WILDER, *M. Am. Soc. C.E., State Engineer, Federal Emergency Administration of Public Works*, San Francisco, Calif.

J. C. ALBERS, *Assoc. M. Am. Soc. C.E., City Engineer and Street Superintendent*, Glendale, Calif.

IRRIGATION DIVISION

Morning and Afternoon

9:00 Committee Reports

9:30 Variations in Runoff of Western Streams

S. T. HARDING, *M. Am. Soc. C.E., Professor of Irrigation, University of California*, Berkeley, Calif.

Discussion by

LYNN CRANDALL, *M. Am. Soc. C.E., Watermaster, Snake River, District 36*, Idaho Falls, Idaho.

ROBERT FOLLANSBEE, *M. Am. Soc. C.E., District Engineer, U. S. Geological Survey*, Denver, Colo.

11:30 Recent Construction in Western Water Conduits—from the Viewpoint of Capacity and Flow Conditions

FRED C. SCOBEY, *M. Am. Soc. C.E., Senior Irrigation Engineer, U. S. Department of Agriculture*, Berkeley, Calif.

Recess for Luncheon

1:30 Selection of Material for Construction of Rolled Earth-Fill Dams

CHARLES H. LEE, *M. Am. Soc. C.E., Consulting Hydraulic Engineer*, San Francisco, Calif.

Discussion by

C. H. HOWELL, *Esq., Flood Control Engineer, Los Angeles County*, Los Angeles, Calif.

H. A. VAN NORMAN, *M. Am. Soc. C.E., Chief Engineer and General Manager, Department of Water, City of Los Angeles*, Los Angeles, Calif.

THURSDAY—July 4, 1935 (*Continued*)

CONSTRUCTION DIVISION

Afternoon

2:00 **Morris Dam**

VERNE L. PEUGH, *Assoc. M. Am. Soc. C.E., Construction Engineer, Pasadena Water Department*, Pasadena, Calif.

2:30 **Discussion by**

WALTER L. HUBER, *M. Am. Soc. C.E., Consulting Engineer*, San Francisco, Calif.

KENNETH Q. VOLK, *M. Am. Soc. C.E., Resident Engineer, Metropolitan Water District of Southern California*, Los Angeles, Calif.

2:50 **Aqueduct Tunnels**

J. L. BURKHOLDER, *M. Am. Soc. C.E., Assistant General Manager, The Metropolitan Water District of Southern California*, Banning, Calif.

3:20 **Discussion by**

J. CARSON AGNEW, *M. Am. Soc. C.E., Director, Winston Brothers Company*, Los Angeles, Calif.

L. E. DIXON, *Esq., President, L. E. Dixon Company*, Los Angeles, Calif.

3:40 **Large Siphons Under High Heads**

N. D. WHITMAN, *Assoc. M. Am. Soc. C.E., Chief Engineer, American Concrete and Steel Pipe Company*, South Gate, Calif.

4:10 **Discussion by**

D. B. GUMENSKY, *Assoc. M. Am. Soc. C.E., Assistant Engineer, Metropolitan Water District of Southern California*, Los Angeles, Calif.

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FLEET AT ANCHOR IN LOS ANGELES OUTER HARBOR

SANITARY ENGINEERING DIVISION

Afternoon

2:00 **Improvements in Chlorination at Los Angeles**

RAY L. DERBY, *Assoc. M. Am. Soc. C.E., Assistant Sanitary Engineer, Department of Water and Power*, Los Angeles, Calif.

2:30 **Discussion**

2:50 **Sludge Disposal and Odor Control at the Pasadena Activated Sludge Treatment Plant**

HARVEY W. HINCKS, *M. Am. Soc. C.E., City Engineer and Superintendent of Streets*, Pasadena, Calif.

O. H. HEDRICH, *Esq., Mechanical Engineer*, Pasadena, Calif.

WILLIAM A. ALLEN, *Esq., Assistant Superintendent, Pasadena Sewage Disposal Plant*, Pasadena, Calif.

3:20 **Discussion by**

A. M. RAWN, *M. Am. Soc. C.E., Assistant Chief Engineer, Los Angeles County Sanitation Districts*, Los Angeles, Calif.

ALVA J. SMITH, *M. Am. Soc. C.E., Manager, Los Angeles Office of Black and Veatch*, Los Angeles, Calif.

3:50 **The City of Oakland's Experience in the Disposal of Refuse at Sea**

WALTER N. FRICKSTAD, *M. Am. Soc. C.E., City Engineer* Oakland, Calif.

4:20 **Discussion**

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GENERAL VIEW OF LOS ANGELES INNER HARBOR, FROM WHICH TRIP TO CATALINA ISLAND WILL START

WATERWAYS DIVISION

Afternoon

2:30 **Development of Los Angeles Harbor**

GERALD C. FITZ GERALD, *Assoc. M. Am. Soc. C.E., Consulting Engineer and Vice-President, Los Angeles Board of Harbor Commissioners*, Los Angeles, Calif.

3:00 **Discussion by**

C. T. LEEDS, *M. Am. Soc. C.E., Consulting Engineer*, Los Angeles, Calif.

J. W. B. BLACKMAN, *M. Am. Soc. C.E., City Engineer–Director of Public Service, City of Long Beach*, Long Beach, Calif.

FRANK G. WHITE, *M. Am. Soc. C.E., Chief Engineer, Board of State Harbor Commissioners*, San Francisco, Calif.

3:30 **The Salt Water Barrier Below Confluence of Sacramento and San Joaquin Rivers—Effect on Floods, Salt Water Intrusion, and Navigation**

EDWARD HYATT, *M. Am. Soc. C.E., State Engineer*, Sacramento, Calif.

4:00 **Discussion by**

A. KEMPKEY, *M. Am. Soc. C.E., Consulting Engineer*, San Francisco, Calif.

M. P. O'BRIEN, *Assoc. M. Am. Soc. C.E., Associate Professor, Mechanical Engineering, University of California*, Berkeley, Calif.

THOMAS H. MEANS, *M. Am. Soc. C.E., Consulting Engineer*, San Francisco, Calif.

Entertainment and Social Events

FOR THE LADIES

WEDNESDAY—July 3, 1935—Morning

10:30 Ladies' Drive

Leaving the Ambassador Hotel between 10:30 and 11:30 a.m., the ladies will be taken on a tour through Pasadena, to the San Gabriel Mission and the orange belt, along Foothill Boulevard to Claremont, and thence to Padua Hills, where luncheon will be served at the Padua Hills Dining Room followed by entertainment by the Mexican Players.

All-Year Club Photo

BALBOA PARK AT SAN DIEGO
Site of the California Pacific International Exposition

Tickets for the drive, luncheon, and entertainment are $1.25 each.

The party will return to the Ambassador Hotel in time for the dinner dance and entertainment in the Fiesta Room at 7:00 p.m.

THURSDAY—July 4, 1935—Afternoon and Evening

3:00 Drive, Supper, and Theater for the Ladies

The ladies will leave the hotel by automobile for a drive through Bel-Air, Beverly Hills, and Hollywood. Following the drive, the party will go to the estate of Captain and Mrs. John D. Fredericks in Bel-Air, where a reception and buffet supper will be held in their gardens. After supper the ladies will attend a performance at Grauman's Chinese Theater.

The party will be returned to the Hotel Ambassador by automobile and bus following the performance.

Tickets for the theater are 55 cents each.

FOR THE MEN

THURSDAY—July 4, 1935—Afternoon and Evening

4:00 Golf Tournament at Wilshire Country Club

7:00 Smoker at Wilshire Country Club

Tickets $1.50 each, including the green fee for those playing golf.

Special Trips and Tours of Engineering Interest

FRIDAY—July 5, 1935—Morning and Afternoon

10:30 Visit to Motion Picture Studios

Members and ladies will leave the Ambassador Hotel by automobile and bus for visit to the motion picture studios.

The party will take luncheon (à la carte) in the studio cafés.

If desired, arrangements may be made for visiting nearby points of engineering interest, such as the Los Angeles harbor, reservoirs of the Department of Water and Power, Metropolitan Sanitary District structures, Metropolitan Water District structures, or oil developments. The view from the City Hall Tower may also be seen if desired.

SATURDAY—July 6, 1935

9:00 Trip to Santa Catalina Island

The party will leave the Pacific Electric Station, at Sixth and Main streets, Los Angeles, at 9:00 a.m. sharp, and will leave Wilmington (Los Angeles harbor) on a steamship connecting with the train.

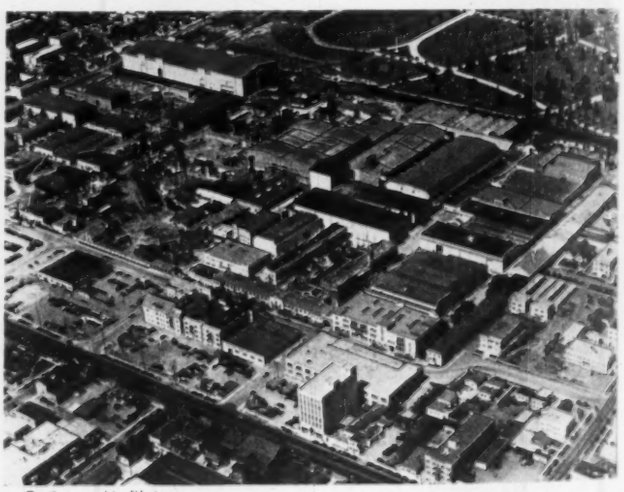
Tickets for the entire trip, including luncheon at the St. Catherine Hotel and a trip in a glass-bottomed boat at Catalina, will be approximately $5.

SUNDAY—July 7, 1935

"American Society of Civil Engineers' Day" at California Pacific International Exposition

The San Diego Section of the American Society of Civil Engineers will be hosts to members and guests at the Convention at the California Pacific International Exposition in San Diego.

This day has been specially designated "American Society of Civil Engineers' Day" at the Exposition.



© *Spence Air Photos*

ONE OF THE MAJOR MOTION PICTURE STUDIOS
To Be Visited During the Convention

Hotel Rates—Announcements—Railroad Rates

Hotel Rates

Hotel	Single Rooms with Bath	Double Rooms with Bath
Los Angeles Ambassador, Convention Headquarters	$5.00 up	$7.00 up
Langham (Hotel Apartments)	3.00 up	5.00 up
Mayfair (free car storage)	2.50 up	3.00–4.00
Los Angeles Biltmore	3.50 up	5.00 up
Clark	2.50 up	3.50–4.00
Mayflower	2.50 up	2.50–3.00

The Ambassador Hotel is located in the residential section of the city. The Biltmore, Clark, and Mayflower are in the downtown business district. The Langham Hotel Apartments, three blocks from the Ambassador, have a limited number of rooms available. The Mayfair Hotel lies between the Ambassador and the business district.

As the Convention will take place during the San Diego Exposition and the summer tourist season, members are urged to make reservations early to avoid disappointment. Those intending to stay at the Ambassador will please notify the management of their connection with the Convention when making reservations.

Convention Tour for Members from the East and Middle West

Members residing in the East and Middle West will be interested in the plans for an all-expense tour to Los Angeles. The group will concentrate at Chicago, with stopovers at Colorado Springs, Denver, and Salt Lake City. Three days will be spent in the wonderful National Parks in southern Utah, including Zion, Bryce Canyon, and Cedar Breaks, with another day devoted to an inspection of Boulder Dam. The group will arrive in Los Angeles on Sunday morning, June 30.

Following is an itinerary of the tour:

June 18. Leave New York and other eastern and southern cities for Chicago.

June 19. Leave Chicago 11:45 p.m. via Burlington Overland Express.

June 21. Arrive Colorado Springs 9:30 a.m. Morning to be occupied with a motor tour through the Garden of the Gods, to Seven Falls, and to the Cave of the Winds, and afternoon to be open for a trip to Pike's Peak if desired. Leave Colorado Springs 5:30 p.m., arriving Denver 8:40 p.m., the group staying at the Hotel Cosmopolitan.

June 22. All day motor tour, including Denver Mountain Parks, Lookout Mountain, Lariat Trail, Clear Creek Canyon, Echo Lake, Mount Evans, Squaw Pass, Bear Creek Canyon, and Red Rocks.

June 23. Forenoon, a motor tour of Denver. Leave Denver 3:30 p.m. via the Moffat Tunnel and Dotsero Cutoff.

June 24. Arrive Salt Lake City 7:30 a.m., the party stopping at the Hotel Utah. Morning, motor tour of the city; noon, organ recital in the Great Temple. Leave Salt Lake City during the night.

June 25. Arrive Lund. Motor trip to Cedar City and to Zion National Park.

June 26. Motor tour via the Mount Carmel Highway and White Cliffs for Bryce Canyon National Park.

June 27. At Bryce Canyon National Park. Motor trip to Inspiration Point, Bryce Point, Little Bryce, Natural Bridge, and Rainbow Point.

June 28. Motor to Cedar Breaks and through Cedar Canyon to Cedar City, taking the train in the afternoon to reach Las Vegas 9:25 p.m. the group staying at the Hotel Apache.

June 29. Motor excursion to Boulder Dam, leaving 9:25 p.m.

June 30. Arrive Los Angeles 8:30 a.m.

The rates for this tour include round-trip rail transportation; Pullman lower berth from point of departure to Los Angeles; all meals from Chicago to Los Angeles; hotel rooms with twin beds and bath, two persons in a room (single rooms throughout are $14.00 additional); all motor transportation for the National Parks, city sightseeing and mountain excursions, with guides, admissions, and road tolls; transfers between stations and hotels.

Inclusive prices, with rendezvous in Chicago, are as follows:

Boston	$296.00	New York	$287.50
Buffalo	267.00	Philadelphia	283.25
Chicago	237.25	Pittsburgh	263.75
Cincinnati	253.00	Richmond	278.00
Detroit	253.50	Toronto	265.00
Montreal	282.75	Washington, D.C.	277.25

Inclusive prices, from Colorado Springs, are as follows:

Atlanta	$252.25*	Memphis	$233.75*
Dallas	217.25*	Minneapolis	233.00
Jacksonville	263.75*	New Orleans	234.00*
Galveston	221.75*	Omaha	216.50*
Kansas City	216.50*	St. Louis	228.50*

* Prices will be slightly higher for those returning via Portland, Seattle, or the Canadian Rockies.

All prices are based on fares announced for 1934. It is not expected that there will be any change. Should rail fares be reduced, that reduction will be reflected in the corrected rates, and should they be increased these prices will be raised by that amount.

The Convention in Los Angeles will offer a variety of return routes for those who wish to visit other points in the United States on their return.

Members interested in joining this tour should write promptly to the Secretary of the Society or directly to Leon V. Arnold, 36 Washington Square West, New York, N.Y., who is in charge of the arrangements.

Entertainment for the Ladies

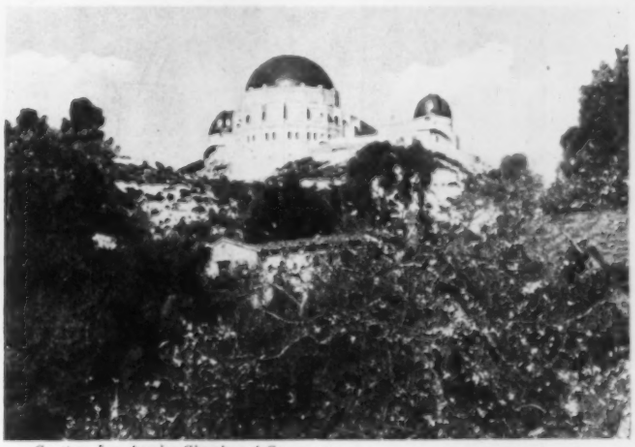
Attention is directed to the program of entertainment for the ladies. The ladies are invited to participate in all the other features of the Convention that may be of interest to them.

Invitation to Student Members

All members of Student Chapters are invited to attend and participate in all the events of the Convention.

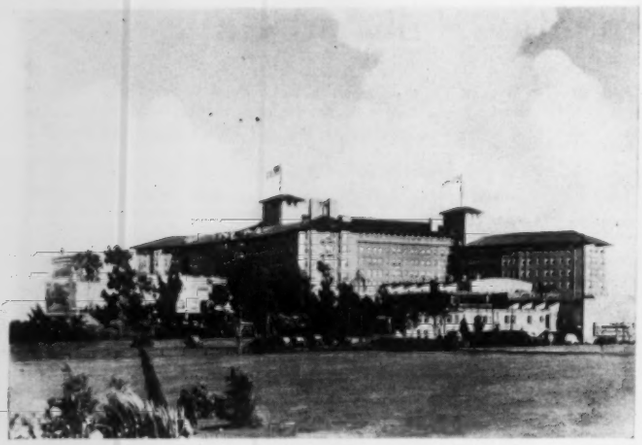
Union Pacific Railroad Photo

GUEST CABINS IN ZION NATIONAL PARK
Magnificent View from Shelters Provided for Tourists

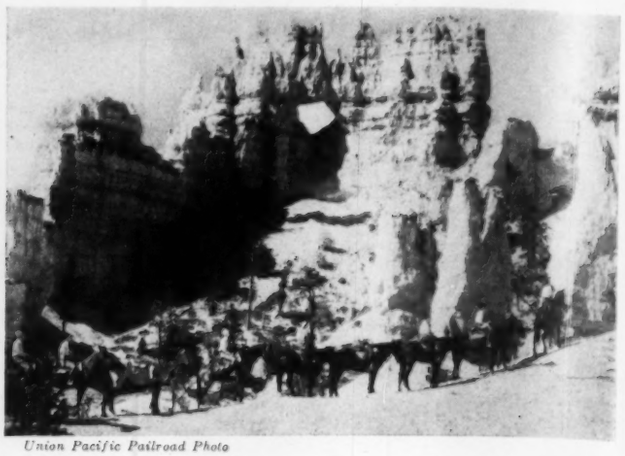


Courtesy Los Angeles Chamber of Commerce

NEW GRIFFITH PARK PLANETARIUM, LOS ANGELES
To Be Open to Visitors at the Time of the Convention



AMBASSADOR HOTEL, WHERE CONVENTION MEETINGS WILL BE HELD



Union Pacific Railroad Photo

TRAIL PARTY IN BRYCE CANYON NATIONAL PARK

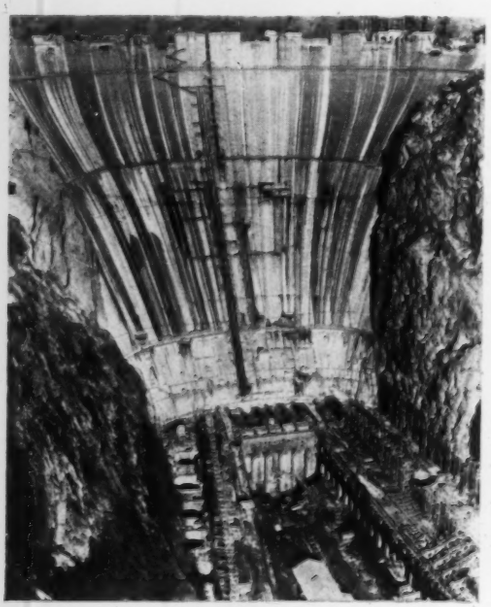
Reduced Railroad Rates

Excursion rates in effect at the time of the Convention will make the cost of transportation moderate. The following table gives the cost of round-trip fares and one-way Pullman rates to Los Angeles from various cities:

	45-DAY LIMIT	OCT. 31 LIMIT	LOWER BERTH	UPPER BERTH	COMPARTMENT	DRAWING ROOM
Boston	$133.98	$144.95	$25.88	$20.70	$73.00	$92.00
Buffalo	109.55	116.10	21.38	17.10	50.25	77.00
Chicago	....	86.00	15.75	12.60	44.50	56.00
Cleveland	101.35	105.65	19.50	15.60	55.00	69.50
Denver	....	57.50	11.00	8.80	21.00	39.00
Detroit	98.30	101.70	19.50	15.60	55.00	69.50
Indianapolis	92.60	95.21	19.50	15.60	55.00	69.50
Kansas City	....	72.00	13.25	10.60	37.50	47.00
Memphis	....	85.15	14.50	11.20	41.00	51.00
New Orleans	....	85.15	14.50	11.20	41.00	51.00
New York	126.90	138.35	24.75	19.80	70.00	87.50
Omaha	....	72.00	13.25	10.60	37.50	47.00
Pittsburgh	107.10	113.05	20.25	16.20	57.25	72.50
Philadelphia	122.85	133.10	24.00	19.20	67.75	86.00
St. Louis	....	81.50	15.00	12.00	42.00	53.00
St. Paul	....	86.00	15.75	12.60	44.50	56.00
Washington	120.75	126.20	24.00	19.20	67.75	86.00

Local Committee on Arrangements

W. W. HURLBUT, *Chairman* A. M. RAWN, *Vice-Chairman*



DOWNSTREAM FACE OF BOULDER DAM
World's Largest Power Plant

Subcommittees

Entertainment Committee: A. M. RAWN, *Chairman*, FRED D. BOWLUS, C. E. ARNOLD.

Transportation Committee: MILO C. HALSEY, *Chairman*, C. W. SOPP, WILLIAM C. HOGOBOOM, CHARLES E. ANGILLY, JR.

Reception Committee: J. B. LIPPINCOTT, *Chairman*, CHARLES T. LEEDS, ROBERT LINTON, RAYMOND A. HILL, FRANKLIN THOMAS.

Program Committee: DONALD M. BAKER, *Chairman*, MYRON C. BURR, HOWARD W. JEWELL, ARTHUR M. TAYLOR, E. C. EATON.

Registration Committee: H. L. DOOLITTLE, *Chairman*, WALTER PUTNAM, ROY L. ANDERSON, A. R. ARLEDGE, DONALD H. MCCREERY, W. L. CHADWICK.

Hotel Committee: KENNETH Q. VOLK, *Chairman*, JULIAN HINDS, HOWARD M. LOY, SAMUEL B. MORRIS, ORMOND A. STONE, PAUL F. GEMPERLE, RALPH R. PROCTOR, CARL B. WIRSCHING.

Excursion Committee: J. E. PHILLIPS, *Chairman*, HARRY W. DENNIS, CLARENCE J. SHULTS, OLIVER D. KEESE, FRITZ W. KARGE, CLAYBURN C. ELDER, W. R. ARMSTRONG.

Publicity Committee: ANDREW L. GRAM, *Chairman*, HARRY F. BLANEY, MELVILLE DOZIER, JR., WAYNE W. WYCKOFF, DAVID M. WILSON, VITRUVIUS ELMENDORF.

Ladies Committee

MRS. ROBERT LINTON, *Chairman;* MRS. A. M. RAWN, *Vice-Chairman;* MRS. RALPH REED, *Registration;* MRS. DONALD M. BAKER, *Reception;* and MRS. MACY JONES, *Excursions*

MRS. ARTHUR H. ADAMS
MRS. JOHN C. ALBERS
MRS. ROY L. ANDERSON
MRS. CHARLES E. ANGILLY, JR.
MRS. PAUL BAILEY
MRS. ARCHER F. BARNARD
MRS. FRANCIS BATES
MRS. FREDERIC A. BATTY
MRS. GARNER A. BECKETT
MRS. HARRY F. BLANEY
MRS. MERRILL BUTLER
MRS. FRANK S. CURRIE
MRS. HARRY W. DENNIS
MRS. H. L. DOOLITTLE
MRS. ROBERT M. FOX
MRS. R. F. GOUDEY
MRS. LOUIS C. HILL
MRS. RAYMOND A. HILL
MRS. JULIAN HINDS
MRS. W. W. HURLBUT
MRS. HOWARD WILLIAM JEWELL
MRS. ALFRED JONES
MRS. D. A. LANE
MRS. RALPH W. LAWTON
MRS. CHARLES T. LEEDS
MRS. J. B. LIPPINCOTT
MRS. W. W. ORCUTT
MRS. J. E. PHILLIPS
MRS. A. L. SONDEREGGER
MRS. ORMOND A. STONE
MRS. FRANKLIN THOMAS
MRS. H. A. VAN NORMAN
MRS. CHARLES D. WAILES, JR.
MRS. CARL B. WIRSCHING

The program as a whole has been prepared under the direction of the Committee on Regional Meetings, HENRY D. DEWELL, *Vice-President Am. Soc. C.E., Chairman;* and IVAN C. CRAWFORD, B. A. ETCHEVERRY, THEODORE A. LEISEN and RALPH J. REED, *Directors Am. Soc. C.E.*

Please call on the Local Committee on Arrangements or on the Secretary's office for any service desired.

SOCIETY AFFAIRS

Official and Semi-Official

Some Pertinent Facts About the Society

Extracts from Remarks of the Secretary Before the Metropolitan Section on April 17, 1935

AT THIS moment the Society has 14,978 members, resident all over the United States and, in fact, all over the world. Approximately 1,000 of these are resident outside continental United States. There are 57 Local Sections. The largest is the Metropolitan Section. Others almost as large are at San Francisco, Los Angeles, and Philadelphia. There are 110 Student Chapters with a membership of 4,300 students. The work of the Society technically is carried on primarily through 10 Technical Divisions, their committees, and the research committees.

Publications provide the main outlets for these technical endeavors. Something like 350 members of the Society assist as experts or reviewers with respect to the papers that are to appear in the Society's publications. Last year 535 authors and discussers took part in the development of the technical articles. Counting those members who have assisted in the preparation of memoirs of deceased members, approximately 1,000 members of the Society are contributing yearly to the material that comprises the publications.

Much could be said of the detail with which the Board of Direction and the local membership committees scan and study prospective members. Seventy local membership committees are doing a tremendous amount of valuable work in maintaining the high standards of membership.

Through designated representatives, the Society is associated in 42 other efforts wherein to a certain degree is expressed the civil engineering viewpoint and which in return react on the Society's work. The activities in which there is participation cooperatively with the other Founder Societies, the many joint meetings, the extensive research work, and dozens of similar elements of the Society's work might be mentioned in detail. Operating nationally on these various topics, and on others not mentioned, more than 300 committees with a personnel of approximately three thousand members of the Society are at work this year and every other year.

A word about finances. The Society is absolutely without debt of any kind, shape, or nature, and on the last day of each month all current bills are paid. The Society is most fortunate in the investments which have been made, one investment being in the Engineering Societies Building and another in the property which the Society formerly used for its headquarters, on 57th Street, New York. From these investments there is received annually $69,000, which is added to other items of income available annually for expenditure.

Present dues amount to $213,000 per year. In addition to the $69,000 mentioned, there is income of $64,000 from other sources. Total income, therefore, for 1935 is estimated at $346,000. The anticipated expenses of this year are budgeted $27,000 in excess of anticipated income. For the past four years it has been the practice of the Board of Direction to budget the anticipated expenditures in excess of anticipated income by between $25,000 and $30,000.

Reducing these figures to the simplest terms, it means that in the year 1935 for every $1.00 collected in dues, the Society is spending $1.75. The greatest expenditure that the Society has made was in its year of prosperity, 1931. That year actual expenditures were $416,000. Since then times have not been so good. Expenses have been reduced generally; the salaries of the staff have been reduced; several committees have been required to slow down their activities; and there have been other curtailments. However, an upturn seems to have set in. It was evidenced first in October 1933. During 1933—the peak of unemployment as far as civil engineers are concerned—delinquencies in the payment of dues amounted to 22 per cent. For 1935 they are approximately 12½ per cent. So far this year applications for admission to the Society are 23 per cent in excess of last year; and last year they were in excess of the year before.

A subject on which much could be said would be with respect to the reemployment of civil engineers. In the early part of the year 1933, the Committee on Salaries made a survey of the degree of unemployment. It was found from several thousand questionnaires forwarded and analysis of the answers received that the peak of all-time employment and the peak of all-time salaries for civil engineers was December 31, 1930.

By another survey it was determined that the maximum of unemployment with respect to civil engineers occurred on October 1, 1933. Information which the committee gathered from responsible heads of departments and responsible engineering organizations all over the country indicated that normally it would have been worse on December 31, 1933; about 45,000 civil engineers would have been out of employment, and the income of the profession at that moment would have been considerably less than half its normal, probably down to only 40 cents or perhaps 30 cents on the dollar, had not CWA given employment to many.

During these past four years a variety of efforts in behalf of reemployment have been successful which were not considered to be an active function of the Society prior to that time. The first act with respect to reemployment was a visit made by a committee of the Society on President Hoover, when he was asked to approve of and assist in carrying forward an expansion of the Federal mapping program. That was in October 1931. Again in 1932, the same subject was brought to the attention of Secretary Chapin of the U. S. Department of the Interior.

In the winter of 1933–1934 the expanded mapping program was accepted by CWA and 14,000 men were put to work, of whom 10,000 were engineers. This work has continued until this time in some 20 states with 2,000 engineers thus employed. As a further consequence, approximately $400,000 has been made available in the city of New York for survey calculations upon which more than 300 engineers have been employed.

Since the first contacts on this matter of reemployment, every Society President has made numerous visits to Washington. One President estimates that he had spent 31 per cent of his working hours on Society activities, and that he visited Washington at the rate of one day of each week during the first six months of his term. Society representatives have conferred with several Cabinet members and upon many occasions, during the past four years, have visited the administration heads of the several federal engineering agencies.

To tell all the details of these visits would not be fair to the administrators. Nor is it practicable to tell of the ideas developed by selected members, delegated to remain in Washington for a short period, in order that there might be dissemination of the especial knowledge and experience of which they were possessed. Neither will results be definitely determinable, except as one looks back at the situation in the light of history.

It appears to be the fact, however, that instead of 45,000 unemployed civil engineers in the United States, there are today not more than 10,000. There is no question whatsoever that through the efforts mentioned, and others initiated within the Society, but about which there has been little demonstration, civil engineers in this country to the extent of 35,000 have been reemployed in the past year and a half. And so, as of April 1935, the profession is about 90 per cent employed, at something—not satisfactorily in many instances, but employed at something.

Correspondence at Headquarters has multiplied tremendously in the past three or four years. Inquiries have come from all over the United States on individual questions and on group questions of many kinds and natures.

Queries having to do with salaries are handled by the Society's Committee on Salaries, whose analysis of salaries of civil engineers has been accepted officially by the PWA and found acceptance in other of the federal departments.

At its January meeting, the Board of Direction decided that under proper circumstances the Society would take up the defense of members who had been unjustly or falsely accused, and a specific case has been recently handled. A vice-president of the Society was commissioned to visit a midwestern state, where for a period of seven days he investigated the situation. In 11 cities he interviewed 23 different people and found that an injustice had indeed been done to two members. His findings have been presented to the proper government official, and request made that the case with respect to these men be reopened, and that the Society be given a hearing.

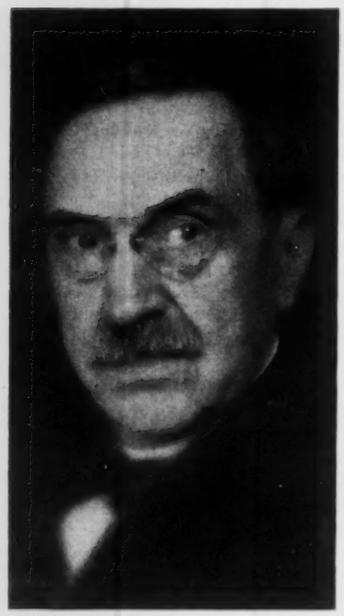
With propriety it appears it may be stated that an organization which is standing up as this one has stood up through the depression—a voluntary organization which now has only 12½ per cent delinquencies, an organization which has 300 committees in existence and 3,000 committee members who are functioning to a relatively high degree, an organization whose Board of Direction has expended much time in the expansion of old or the development of new procedures, which has made generous appropriations to assist its committees and designated individuals to take on these various activities—is a pretty solid body.

These typical details indicate that the Society not only is capable of providing leadership, but that it is providing leadership. If one considers thoughtfully the loyalty, the readiness to serve, and the enthusiasm of the members of this national organization, one must realize that there is full opportunity and will continue to be full opportunity for leadership. The major problem at the moment is a determination of how this leadership can be made more effective locally, how full acceptance can be achieved at all points throughout the country, wherever members may reside, of such possibilities as leadership may develop. This is the problem now under intimate study by the Committee on Aims and Activities.

Charles F. Loweth, 1857–1935

MEMBERS of the Society, and especially those in the Middle West, will be shocked to learn of the death of Charles F. Loweth on May 15, 1935. Only two weeks earlier he had retired after long service with the Chicago, Milwaukee and St. Paul Railroad and had been made consulting engineer. His connection with the railroad, which began in 1901, was continuous thereafter. He became chief engineer in 1910. A professional trip to Washington, D.C., following his resignation from the railroad, proved a more severe strain on his health than he realized.

For most of his professional life he was actively interested in Society affairs. In fact, he was one of the oldest Society members in point of continuous affiliation, having joined in 1883. In addition to his normal efforts for every worth-while activity of the Society, he served in numerous official capacities, notably as Director for the years 1910–1912, Vice-President for the term 1914–1915, and President in 1923.



THE LATE CHARLES F. LOWETH

Those who had contact with Mr. Loweth in any of these activities will remember the conscientious and painstaking manner in which he handled every responsibility. He was widely esteemed for his personal character and professional attainments.

At the funeral, held at his home in Chicago on May 17, a large number of friends and associates gathered to do him honor. During the service tribute was given to three dominant characteristics—his humility, his strength, and the simplicity of his love, showing itself in his loyalty and truthfulness. Interment was in Oak Woods Cemetery. A. J. Hammond, Past-President Am. Soc. C.E., and T. L. Condron, M. Am. Soc. C.E., who served with Mr. Loweth on the Board of Direction, assisted as pallbearers.

More complete tribute to the worth and accomplishments of Past-President Loweth will appear when his memoir is prepared for publication in TRANSACTIONS.

Student Chapter Activities Expand

OVER forty thousand students and guests attended the meetings of the 109 Student Chapters in this country during the academic year 1933–1934, according to the recent annual report of the Committee on Student Chapters. This committee has encouraged each Chapter to adapt its organization and activities to its local situation. As a result of this policy, some Chapters operate practically on a seminar basis, others emphasize student papers, while a third group does little more than arrange for talks by outside engineers. During the past academic year, 51 per cent of all papers were delivered by students, 11 per cent by faculty members, and 25 per cent by outside engineers, while 13 per cent were lantern lectures provided by the Society.

In connection with the work of the committee, a memorandum from the Society to the presidents and secretaries of the various Student Chapters throws an interesting side light on some of the problems arising in the schools. A few excerpts from this memorandum are of especial interest:

"While some Chapter reports disclose no particular, or very few, serious problems in their conduct, there are some excellent results being realized under adverse or limited circumstances. The great need seems to be inspiring contact with the professional or practicing field."

"Undoubtedly every faculty member has experienced at some time the rueful experience of finding that the opinions of a person outside the academic circle will frequently receive more attention than those identical opinions received when presented by the faculty member. Then too, the contact member is an emissary from the world of practice into which the young man hopes to plunge upon graduation, and will therefore be invested with an authoritative air that is sometimes denied to the equally competent professor."

"There is no alternative to the genuine interest and regular attendance of the faculty adviser. It is doubted whether any really good Chapter can be found in which the adviser functions only in a perfunctory manner."

The committee has recently taken up seriously the formulation of a manual for Student Chapters. Material is now being collected, and it is hoped that an acceptable draft will be ready by the end of the year.

The committee approves particularly the holding of local conferences in which Chapters of nearby or adjoining schools participate. For example, inter-Chapter meetings are developing in Louisiana and in Virginia; are proposed for the Carolinas; could very well be developed in the Tennessee Valley, and perhaps in the District of Columbia and Maryland jointly. Four Student Chapter conferences have been held recently, at Swarthmore, Pa., on April 17; at Lexington, Va., on April 5 and 6; at Durham, N.C., on April 26; and at New York, N.Y., on May 3.

A Difficulty Cleared Up

FULL acknowledgment should be accorded Federal officials of the Home Owners Loan Corporation for the cooperation they recently rendered the Society. Last November it was learned that a Society member who had been making lot surveys, on instructions from the Home Owners Loan Corporation, had been awaiting, for more than a year, payment of a bill of $680 for surveys he had made. These were in connection with loans that later had been declined. The situation seemed to call for a Society inquiry.

Immediately a letter was sent from Headquarters to Federal officials in Washington calling their attention to the particular instance and expressing the opinion that, if proper instructions were issued by officials of the Home Owners Loan Corporation, such

engineering services should be paid for as promptly as stenographic, telephone, or any other services or materials involved in the administration of the work. Further inquiry by the Society developed the interesting fact that two other members in the same neighborhood were also awaiting delayed payments, presumably for the same reason—that the applicants' requests for loans had been declined.

In addition letters were written to all the Local Sections to determine the extent to which similar conditions prevailed throughout the country. Replies from the great majority of the Sections indicated that the troublesome condition seemed to be entirely local. Correspondence was maintained between the engineers affected, Society's Headquarters, and the Federal officials in Washington. The Society's protests were considerately received, the result being that early in 1935 payments were made for all deferred claims, amounting to a total of over $2,000.

It is gratifying to record the success secured by cooperation in this worth-while effort. Much credit is due to Society members and Local Sections, but particular appreciation is owed to the government officials concerned, who were open-minded in recognizing that there was basis for a legitimate complaint and conscientious in promptly taking the necessary action.

North Carolina Section Holds Conference of Student Chapters

THREE ENGINEERING colleges were represented in the conference of Student Chapters held in conjunction with the annual meeting of the North Carolina Section, which assembled in Durham, N.C., on April 26, 1935. These schools were Duke University, North Carolina State College, and the University of North Carolina.

The conference was opened by C. L. Mann, M. Am. Soc. C.E., Professor of Civil Engineering at the North Carolina State College of Agriculture and Engineering. The second speaker was H. C. Bird, M. Am. Soc. C.E., Professor of Civil Engineering at Duke University, and the third was Walter E. Jessup, Field Secretary of the Society. Mr. Jessup described the work of several Student Chapter conferences that he had attended recently and explained the value of an organization of Student Chapters.

Professor Bird then presented a proposed constitution, which had been formulated after a study of all available constitutions adopted by similar student groups. This document was explained and discussed paragraph by paragraph and after suitable modification was adopted. Professor Bird then announced that because of delay in getting the organization started, officers for the coming year would be elected at the meeting instead of by the method given in the constitution. Officers were then elected as follows: C. Ballenger, of Duke University, chairman; R. L. Soultatous, of North Carolina State College, vice-chairman; J. A. Westbrook, of the University of North Carolina, secretary-treasurer. Chairman Ballenger then took over the meeting and invited the conference to hold its next meeting at Duke University, in the fall of 1935.

Questionnaires for Engineering Survey Mailed

ARRANGEMENTS are now complete to launch the survey of the engineering profession through mailing of all questionnaires by May 31, according to Dr. Isador Lubin, Commissioner of Labor Statistics. The closing date for their return is July 8. Andrew Fraser, assistant chief of the Division of Wages, Hours, and Working Conditions, will be in complete charge of the questionnaires.

By actual count, the total number of questionnaires ready to be mailed is 173,151, unduplicated. This is considerably in excess of the 166,000 which were sent to Washington at the conclusion of the sorting process described in CIVIL ENGINEERING for March, and represents accretions of cards received too late to be included in the main file before sending it to Washington.

As shown in the accompanying Table I, New York engineers to the number of 30,564 will receive questionnaires. The next largest group is in the state of Pennsylvania, totaling 16,252, while California, with 12,660 is closely followed by Illinois with 12,197, and New Jersey with 11,337.

Since the collection of names was dependent to a certain extent on the secretaries of engineering societies, the figures in the attached table will more nearly represent the true engineering population in areas where most of the engineers belong to professional organizations.

It is hoped that every engineer who receives a questionnaire will answer it promptly and completely in order that the survey may be of the greatest possible value to the profession in connection with problems of employment, salary, education, and other matters. It is essential that every engineer should respond so that the results will be in the nature of a census rather than a mere sampling of the profession.

TABLE I. NUMBER OF NAMES, LISTED BY STATES, TO WHOM QUESTIONNAIRES WERE SENT

State	Number Sent	State	Number Sent
Alabama	1,083	Nebraska	930
Arizona	2,039	New Hampshire	653
Arkansas	443	New Jersey	11,337
California	12,660	New Mexico	396
Colorado	2,430	New York	30,564
Connecticut	3,257	Nevada	285
Delaware	572	North Carolina	1,349
District of Columbia	3,661	North Dakota	387
Florida	1,830	Ohio	8,648
Georgia	3,411	Oklahoma	1,385
Idaho	654	Oregon	986
Illinois	12,197	Pennsylvania	16,252
Indiana	4,097	Rhode Island	1,388
Iowa	2,383	South Carolina	908
Kansas	1,987	South Dakota	582
Kentucky	1,000	Tennessee	1,230
Louisiana	1,250	Texas	3,433
Maine	874	Utah	766
Maryland	1,957	Vermont	468
Massachusetts	9,428	Virginia	1,804
Michigan	6,408	Washington	2,431
Minnesota	3,498	West Virginia	1,277
Mississippi	726	Wisconsin	2,867
Missouri	3,794	Wyoming	409
Montana	777		
		Total for survey	173,151

If any professional engineer, or anyone who has qualified as an engineer in the past, fails to receive a questionnaire by about June 10, he is requested to write for a blank to Andrew Fraser, U. S. Bureau of Labor Statistics, Department of Labor, Washington, D.C.

Pamphlet Issued on Salaries and Fees

PREVAILING RATES of salaries of civil engineers as of the first quarter of 1934, and recommendations for determining fees to be allowed for professional engineering services on federal and federal-aid projects undertaken as an aid to industrial recovery or to relieve unemployment, are the subjects treated in a pamphlet recently published by the Society and mailed to all members of the Society on May 18, 1935.

To determine prevailing salary rates, the Committee on Salaries used as a basis the salaries paid to 16,046 engineers and assistants in 48 state highway departments in 1930, from which median salaries were determined. Seven classifications of positions were adopted, and comparisons were made with salaries paid in previous years and with the actual salaries of 28,400 engineers under other conditions of employment. The influence of geographic and social conditions on salary rates is provided for by percentage factors. This report was approved by the Board of Direction on July 10, 1934.

The fees for professional engineering services, recommended primarily for use on federal or federal-aid projects, are designed to reimburse the engineer for out-of-pocket expenditures and a moderate overhead expense, and to afford modest compensation for time and services. The recommendations were approved by the Board of Direction April 3, 1935. The tabulated fees and comments thereon are based on the principles set forth in the Society's Manual No. 5, adopted July 7, 1930.

Both of these reports on salaries and fees have been assembled and reprinted in the current pamphlet. It consists of 12 pages in the convenient 6 by 9-in. size, bound in blue cardboard. A copy was mailed to each member about the middle of May, in the expectation that the material would serve a most useful immediate purpose in connection with proposed engineering employment of major proportions. Additional copies of the booklet may be obtained at 20 cents each.

Making Work Relief Effective

Society Cooperates with National Efforts Through Construction League

DURING THE last few weeks great progress has been made in relating the efforts of the construction industry to the orderly procedure of work relief under the recently passed Emergency Relief Appropriation Act of 1935.

Earlier in the year a call was made on the President by officers of the Construction League of the United States for the purpose of interesting him in making fullest use of the knowledge, skill, and facilities of engineers and architects in private practice, together with contractors and subcontractors. As an outcome of this call, a special Committee on Work-Relief Act had been set up by the league, composed of S. F. Voorhees, M. Am. Soc. C.E., chairman, representing the architects; George T. Seabury, M. Am. Soc. C.E., representing the engineers; E. J. Harding, representing the general contractors; Gordon P. Marshall and John H. Zink, representing the special contractors; F. P. Byington, representing the manufacturers; and B. R. Value, secretary.

According to the announcement of the President, this relief work was to go forward with what he called a security wage, which was to be lower than prevailing wages but higher than the present relief wages. In effect, this means that for the period of the emergency, concessions adapted to the emergency conditions are necessary. This was recognized by all the members of the committee as appropriate, and in that spirit they spent several days in drafting a brief which gave expression to the general thought. At the same time the various interests submitted lesser briefs indicating the point of view which they individually should hold with respect to this general work.

The President had authorized certain representatives of the federal government to meet with the committee and to discuss the proposal. These federal officers suggested that the committee make an effort to be specific as regards forms of contracts that might be drawn up for the utilization of the services of engineers and architects in private practice and similarly of contractors and subcontractors. The result was a memorandum of recommendations for construction under the Emergency Relief Act, consisting of ten parts, which will be described briefly with quoted excerpts from some of the documents.

SOME GENERAL PRINCIPLES ENUNCIATED

In its memorandum the special committee recommended specific principles of procedure. It suggested a practical occupational classification as indispensable, giving complete details of the special qualifications of all workers eligible for employment.

It recommended that professional services be secured on a percentage fee basis whenever feasible, and otherwise on a daily or weekly fee plus overhead and assistants' salaries.

"Architects and engineers to be thus engaged should be properly qualified for the specific types of professional services they are to render."

Selection of architects and engineers should be done locally through properly constituted architectural and engineering boards whose members should be required to agree to non-participation in the actual work under the program, and who would be compensated on a basis of either actual expenses or time expended or both. The members of the national and local qualification and selection boards should be appointed by the President from nominations made by the Construction Code Authority."

Preference was expressed for the prosecution of construction contracts under a lump sum or unit price method through competitive bidding. Otherwise, a fixed fee under a management type of contract might be used, with provision for the scale of wages to be paid to each class of employee. For the latter type of contract, awards should be made through local industry boards, free from any commercial contact with the work itself and properly compensated.

Where materials cannot be purchased in a normal way, it was suggested that the government might make purchases direct, but only for a few standard items and in carload lots.

Finally, the committee concluded, "A national advisory body, representative of the construction industry should be established by the President to aid and advise the administration in the formulation of broad policies and procedure to the extent that the work relief program utilizes construction as a means of accomplishing its purpose."

OCCUPATIONAL CLASSIFICATION SUGGESTED

Following the statement of general principles, there was presented a report on the proper choice of employees, to fulfill the President's stated purpose of putting the unemployed through a course of occupational therapy to restore their morale. A number of excerpts from this document prove enlightening.

"A practical, accurate occupational classification of the persons to be given employment under the program is an essential prerequisite to success in this unprecedented enterprise . . . .

"The formulation of the public works program should wait upon the classification of those for whom it is to provide employment. Valuable time will thus be saved . . . .

"If the purposes of the public works program are to be accomplished in the construction industry; if recovery in that industry is to be stimulated and the morale of the workers restored, it is essential that only those persons be selected from the relief rolls for employment on construction who are able to establish their competency for such employment . . . .

"To insure the selection of competent workmen for construction projects, those on the relief rolls must be classified on the basis of their experience, training, and skill in the several occupations provided. Each person claiming to qualify for employment on construction must be subjected to examination, his employment record investigated and his competence satisfactorily demonstrated . . . .

"Closely related to and dependent upon the occupational classification of the unemployed, is the procedure for placing them in jobs. There should be only one employment service. Duplication of such service will result in confusion, and in placement of incompetents, or the duplication of enrolments . . . .

"The occupational classification here recommended is not new and untried. There is ample precedent for it in this country. Precisely this procedure was adopted by the U. S. Army during the World War and carried through with admirable precision and speed."

Rounding out the report was an extensive list of occupations in construction work subject to the recommended classifications.

PROVIDING FOR PROFESSIONAL SERVICES

On the subject of architectural and engineering contracts, another report was submitted. As it gave condensed yet explicit principles on which to base such contracts, it is reproduced herewith substantially in full, as follows:

"Where public works or work relief is to be the method of providing relief for unemployment, the design of those public works or work-relief projects is an essential prerequisite if any considerable degree of efficiency, or even of safety, is to be attained.

"Regular employees in public agencies and private enterprise should not be replaced by persons drawn from relief rolls, nor should the work customarily performed by such agencies and enterprises be transferred to new agencies created to provide employment for relief workers.

"If, however, those now on relief are to be afforded work, a prompt development of new projects is essential and it is equally essential that existing local architectural and engineering establishments be engaged forthwith to design the projects.

"Such engagements can be made wherein the existing staffs of such architectural and engineering establishments will be reinforced by assistants drawn from the relief rolls. The engagement should preferably be on a percentage fee basis wherein the architect or engineer assumes obligations protective of the government. On the other hand, where technical assistants are on the relief rolls, a type of agreement can be developed wherein the architect or engineer shall be required to use these technical assistants in supplement to his regular principal assistants and to supplement his own professional services.

"Such agreements should be much the equivalent of reimburse-

ment to the architect or engineer of his out-of-pocket expenses plus an agreed-upon fee for his personal services."

PRINCIPLES UNDERLYING CONSTRUCTION CONTRACTS

Next in order was a memorandum on construction contracts for the work-relief program. In discussing the type of contracts for various classes of work, the report stated:

"The question of when work should be undertaken on a lump sum or unit price basis, or on a management fee basis, will have to be determined for various classes of work or, in many instances, by the conditions surrounding individual projects.

"The principal factors which will affect the decision are: (1) type of work, (2) locality, (3) availability of skilled labor, (4) state of preparation of plans and specifications. The importance of these conditions will vary with different types of work.

Large buildings and housing projects require a large percentage of skilled labor. Projects of this character can be let on competitive lump bidding where large pools of skilled labor can be drawn not only from the relief rolls but also from the National Unemployment Service and from organized labor. Where such projects are undertaken at a distance from labor pools, the cost of subsistence or transportation or both should be borne by the Government.

"Heavy construction work such as hydro-electric plants, grade-crossing elimination, flood control projects, canals, and irrigation works are in many cases located in isolated places. Such work is now being successfully carried on under unit price contracts with a very large percentage of workers drawn from the U. S. Employment Service. The use of unit price contracts reduces the time necessary for preparation of plans before initiating the work.

"Highway construction is now being carried on largely by unemployed under the lump sum or unit price contract system. The delay in initiating such work is due to time spent in preparation of plans, but these are necessary in any work before such work can be started. Work on county or secondary highways can be more quickly started under the contract system, but there is not a very great amount of this work within the reach of the centers of unemployment . . . .

"Soil erosion, reforestation and other types of conservation projects can probably be initiated more quickly and carried on more advantageously by management contracts. The same is true of small and simple projects where it is desired to carry on the preparation of plans and actual work at the same time. Certain preparatory work on large projects can also be performed under management contracts in order to expedite starting the work."

In addition to the proper choice of contractors and employees, this report stated that: "Wages that must be paid to each class of employee should be predetermined for each project and stipulated in each contract.

"Provisions should be made for the assignment of apprentices or helpers to every construction project based upon a practicable working ratio to the number of skilled workers employed."

Details were also given as to the several types of contracts, including the lump sum or unit price form, and the management form. Likewise, recommendations as to materials and labor were presented.

PURCHASING MATERIALS TO BEST ADVANTAGE

Enlarging upon the desirable method for purchasing materials for construction work, a separate chapter was added to discuss in detail many of the essential features. These suggestions were based on the policy that economically it is advisable that each project should be decentralized, becoming a local problem so to speak, in which it is necessary to harmonize the various factors of architect, engineer, general contractor, subcontractor, foremen and workers, and materials supplied, a combination that will vary for every separate job. The extensive recommendations and conclusions are essentially practical and useful, with the evident intent of promoting both efficiency and economy.

PROFESSIONAL CONTRACTS AND REMUNERATION

Next in order in the series of reports were two forms of contracts, each presented separately. One, submitted by an architects' committee, gave *in extenso* the form proposed for use by architects on new government projects. Similarly, a form of engineers' contract for federal and federal-aid projects on a percentage fee basis was presented. This document was drawn up especially with the idea of suitability for present conditions of government employment. It provides for adequate protection of the interests of both the engineer and the government, and gives in detail the duties of the engineer, the schedule of work, and payment. A copy of this agreement is reproduced in full on an adjoining page. As this issue goes to press the form of engineer's contract providing for the use of technical assistants on the relief rolls, or unemployed, is under development by a Society committee for presentation to government officials.

Also appended to this group of reports were two covering the remuneration of engineers. The first gave recommended engineering fees for federal and federal-aid projects. These recommendations were given in complete form in the May issue. The second of the two reports covered remuneration on a salary basis, as previously given in full in the April 1934 CIVIL ENGINEERING. These reports have been assembled and reprinted as a separate pamphlet, which was forwarded to every member about the middle of May.

OPTIMISM JUSTIFIED

It is hoped that this complete and well-rounded series of documents will cover in explicit form most if not all of the requirements of government construction under the expanded program. That the Society's efforts will thus be helpful in improving the economic condition of engineers generally is the confident expectation of those officers and committees who have assisted in bringing the present proposals into being.

Joint Functional Units of National Engineering Societies Meet

A MEETING of the engineering societies' eight joint functional organizations, held at the Engineers' Club, New York City, on May 20, 1935, resulted in bringing these various groups into closer contact. A total attendance of over 85 was reported, including officers and directors of the four Founder Societies and officers of their jointly sponsored groups.

The meeting was in charge of Arthur S. Tuttle, President of the Society, who presided. The toastmaster was Dr. Harvey N. Davis, the president of Stevens Institute of Technology. Harold V. Coes, president of the United Engineering Trustees, Inc., described the work of this holding corporation for the Founder Societies, which acts as administrator of joint real estate and financial affairs. Then Dr. Walter L. Schlichter, treasurer of the American Institute of Electrical Engineers, stated that in view of the fact that 25 per cent of the inquiries at the Engineering Societies Library are made by mail, a plan of loaning books by mail is being worked out. Some facts about The Engineering Foundation, an institution "for the furtherance of research in science and engineering, or for the advancement in any other manner of the profession of engineering and the good of mankind" were outlined by H. P. Charlesworth, former president of the American Institute of Electrical Engineers. In the absence of H. E. Coonley, Frederick E. Moskovics, vice-president of the American Standards Association, read a paper describing some of the accomplishments of that body.

Following this address, Maurice Holland, director of the Engineering Division of the National Research Council, presented a paper by Charles F. Kettering, president of General Motors Research Corporation, on the value of research in restoring normal economic conditions. Dr. D. S. Jacobus, a former president of the American Society of Mechanical Engineers, described the work of the Division of Engineering and Industrial Research, one of the seven divisions of science and technology of the National Research Council. Then George T. Seabury, Secretary of the Society, presented a summary of the development of the Engineering Societies Employment Service. In discussing the work of the American Engineering Council, J. F. Coleman, Past-President of the Society, pointed out that coordination of existing agencies rather than the setting up of new ones is the logical route toward professional advancement. Next on the program came C. F. Hirshfeld, chairman of the Engineers' Council for Professional Development, who stated that in his opinion social and economic betterments have lagged behind the development of science, and that attention might well be given to the professional, educational, and cultural phases of an engineer's life, as well as to the technical.

Other speakers were Isaiah Bowman, chairman of the National

Research Council, and Charles F. Scott, a former president of the American Institute of Electrical Engineers. Both delivered interesting addresses on various phases of engineering work. Opportunity for discussion was afforded during the course of the evening.

It is planned to present more detailed accounts of the individual functional groups represented at the conference in an early issue of CIVIL ENGINEERING.

American Engineering Council

The Washington Embassy for Engineers, the National Representative of 222 National, State, and Local Engineering Societies Located in 41 States

NOTES ON WORK RELIEF PROGRAM

PROGRESS under the work relief program has been delayed during the past month, as the setup at the top has gradually taken form. Actual starting of jobs and hiring of men still awaits the approval of individual projects by the new chain of federal boards which have been placed in control.

The setup, briefly, at this moment, starts with a Division of Application and Information, headed by Frank C. Walker, director of the National Emergency Council. Applications for projects are passed from there to an Allotment Division under Secretary Harold L. Ickes. With the President's approval, projects go to a Progress Division under Harry L. Hopkins, who thus is in a key position in the supervision of the actual work. Admiral C. J. Peoples, director of Treasury Procurement, will handle the purchase of materials under the Hopkins division. R. G. Tugwell is expected to take over subsistence homesteads and rural community projects. Rural electrification is under Morris L. Cooke, a member of the American Society of Mechanical Engineers.

Prominent engineers in the higher command include Maj. Gen. Edward M. Markham, Chief of Engineers; Dr. Elwood Mead, Commissioner of Reclamation; and Thomas H. MacDonald, Chief of the Bureau of Public Roads, all on the Works Allotment Division, which takes its place in the alphabetical array as WAD. Frederick E. Schnepfe, Director of Projects, PWA, has been named secretary. With the exception of Mr. MacDonald, these men are members of the Society.

Two billion dollars are to be released from the works fund, according to present plans, for allocation to projects. This represents half of the $4,000,000 to be broken down as previously announced. Each class of work—highways, rural electrification, and the rest—gets, for the present, one-half of the sum ear-marked in the bill.

General policies stand essentially unchanged. From recent presidential statements, it is inferred that relatively small-scale projects, widely scattered, involving a high labor ratio, and possible of completion within a year, will be pushed forward rather than large undertakings, such as dams, where a huge sum would be spent in a restricted area on work that would take several years.

A Department of Conservation and Works is proposed in a bill sponsored by Mr. Ickes and introduced by Senator J. Hamilton Lewis of Illinois. This is designed to permit the President to institutionalize on a long-term basis some of the activities that have developed under the emergency units of the government.

RECENT ACTIVITIES OF THE A.E.C.

The membership of the American Engineering Council continues to expand under the new plan of nominal dues for state and local organizations. Nine societies already have made application, as previously reported, and five more are in process of applying. Membership committees are being set up in each state to encourage more groups to join and to become participants in the steps which the Council is taking toward the advancement of the profession. The state committees are being organized under regional chairmen in each of the nine major divisions of the country. This system of committees is preliminary to the development of the Council's regional public affairs committees, which will permit engineering opinion to be voiced through joint action. The scattering of organizations and lack of coordination in most regions hitherto has led to a dispersion of effort.

A digest of the Brookings Institution reports entitled "America's Capacity to Produce" and "America's Capacity to Consume" has been prepared by the Maurice and Laura Falk Foundation of Pittsburgh, Pa., through whose courtesy the Council has copies for distribution to engineers who wish to study the results of these basic surveys. Requests sent to the headquarters of the Council, 744 Jackson Place, Washington, D.C., will be filled as long as the supply lasts.

A study of the Civil Service system in its relation to engineers will be made by Arthur W. Berresford, former president of the Council, who has consented to do this work unofficially and to make an informal report as a basis for action by the Council. The maintenance of the federal "merit system" is of interest to large numbers of engineers in its relation to salaries, tenure of office, and methods of appointment.

Apprentice regulations affecting engineers have been changed by the Federal Committee on Apprentice Training in response to a request from the Council. Under the apprentice listings, items formerly appeared for chemical, electrical, heating, structural, and ventilating engineers. But the apprentice system, with wages lower than standard, has been applied to engineers only if students in cooperative (part school, part work) colleges. Mr. Morrison Handsaker, administrative assistant of the committee, therefore consented to segregate the engineers under a separate section, specifying that apprentice training should apply only to students of cooperative colleges. This will remove any misunderstanding that might have worked against the interests of the profession.

Washington, D.C.
May 15, 1935

Next Issue of "Proceedings" in August

THE TEN-MONTH publication cycle which ended with the appearance of the May 1935 PROCEEDINGS has been the means of keeping the progressive civil engineer abreast of the times in many subjects—hydraulics, highway design and construction, steel building frames, retaining walls, dams, probability and the theory of structures, rainfall, runoff, transportation of silt in rivers, secondary stresses in structures, filtration plant and practice, water supply engineering, arch dams, river models, economic weight of bridges, structural analysis of cylindrical domes, effect of underground corrosion on metal pipes, surveying problems, effect of torsion, and structural analysis by photo-elastic methods. Discussion has been unusually active during this period. The labor of collating much of this material for the forthcoming Volume 100 (1935) of TRANSACTIONS will occupy the attention of the editorial staff of PROCEEDINGS in the summer months.

One change of policy has gone into effect in connection with the inclusion of material in TRANSACTIONS. In past years, considerable effort has been expended in urging authors to submit their closing discussions in the spring, so that their papers, complete with all discussion, could appear in TRANSACTIONS in the fall. Under this system, all the papers published in PROCEEDINGS in the ten months from August 1933 to May 1934 would remain open for discussion until May 1935, and then would automatically appear in Volume 100 (1935) of TRANSACTIONS, and those published in the ten months from August 1934 to May 1935 would be automatically assigned to Volume 101, to appear in 1936. Under the new system, when the closing discussion of a paper is received before July 1, that paper will be printed in the next volume of TRANSACTIONS, space permitting, regardless of when the paper originally appeared in PROCEEDINGS. Closing discussions received too late for the May PROCEEDINGS will be published directly in TRANSACTIONS. On the other hand, if a closing discussion is received after July 1 of any year, the publication of the main paper and of all discussion of it will be deferred for one year, regardless of when the paper was originally published in PROCEEDINGS.

A number of interesting technical papers are still current in PROCEEDINGS, and discussions are invited from all who are interested. It is particularly desirable that discussion intended for the August PROCEEDINGS be submitted early. This is because discussions intended for this issue accumulate during the summer to such an extent that some of them must necessarily be deferred until September. A complete list of the papers remaining open for discussion is printed on the back of the title page of the May 1935 number of PROCEEDINGS.

Engineering Agreement Fee Based on Percentage of Construction Cost

Draft of General Agreement for Engineering Services on Federal and Federal-Aid Projects on Percentage Fee Basis

ENGAGEMENT of the professional services of engineers, architects, and contractors on the federal and federal-aid projects to be undertaken by the government has been studied effectively by a special committee on the Work Relief Act of the Construction League of the United States, of which the Society is a component member. One of the committee's major objectives was to develop specific forms of agreement for such services. Emphasis was placed on the desirability of maintaining existing governmental, that is, federal, state, and local engineering staffs. But in order that there might be the most rapid practicable expansion of the works program, it was recommended that engineers or engineering organizations normally in private practice be engaged on a percentage fee basis, or on an administrative basis, where technical assistants would be assigned from the relief rolls or from those unemployed, and the engineer or engineering organization would be remunerated for out-of-pocket expenses plus an agreed-upon fee for personal services and the cost of overhead operations. The engineering administrative agreement is in process. The proposed engineering percentage-fee agreement is produced herewith as presented to government officials.

THIS AGREEMENT entered into this.....day of..... 193.., by the United States of America, hereinafter called the Government, represented by the contracting officer executing this contract, and....., of the city of....., in the State of....., hereinafter called the Engineer, witnesseth that the parties hereto do mutually agree as follows:

ARTICLE I. SCOPE OF CONTRACT

The Engineer, for the consideration hereinafter mentioned, shall render complete engineering services required for the design and supervision of construction of (identify the work, its location and the essential elements). In addition to the usual and customary consulting services throughout the design and construction of this project, the detailed services to be furnished by the Engineer are defined in the following articles:

ARTICLE II. SERVICES TO BE RENDERED

Item a. Preliminary Surveys and Explorations

The Government shall furnish all preliminary survey data which it has available, and the Engineer shall make the additional field surveys required for purpose of preparing preliminary studies and such additional field surveys as are required for the making of final designs. These surveys do not include those which may be necessary for the acquisition of real estate. The Engineer will determine the location and extent of such foundation borings and other exploratory investigations as may be needed for the design of the project, shall specify the character and nature of the borings and explorations to be made, and shall supervise the making of such borings and explorations. The Engineer shall supervise such laboratory investigations as are determined necessary for analysis of the borings and explorations. The cost of such borings, explorations and laboratory investigations shall be borne directly by the Government.

Item b. Designs, Drawings, and Specifications

The Engineer will prepare preliminary studies, sketches, and estimates of cost to determine the most suitable types of structures, giving due consideration to economy, strength, utility, appearance, and maintenance. These preliminary studies will be carried on in close cooperation with the contracting officer and must receive the approval of the contracting officer as to type and general characteristics before the preparation of final designs and contract drawings is undertaken.

After the preliminary plans have been approved, the Engineer will:

1. Design all parts of the work with due regard to economy, utility, strength, appearance, and maintenance. In this phase of the work the Engineer, with the approval of the contracting officer, shall retain the services of such specialists as he may consider advisable; the compensation of such specialists to be cared for directly by the Government.

2. Prepare and furnish to the Government a complete set of cloth tracings of contract drawings showing the designs in all their features, the drawings to be in such detail as will show clearly and unmistakably the form, size, and material of all parts and members, and the arrangements of the various parts and members in all portions of the work, all as required for making contracts for the proper construction of the work.

3. Prepare and furnish to the Government four sets of complete specifications for the work, including business clauses, if desired, supplementing the above contract drawings, and covering the methods and requirements of construction and the kind and quality of materials to be used. Federal specifications shall be used for materials, where applicable. If and when requested by the contracting officer, attend lettings and aid in letting contracts by comparing and analyzing bids, investigating qualifications of bidders and furnishing advice on the award of contracts.

All contract drawings, sets of specifications, etc., furnished as indicated above, shall remain in the custody of the Government, and be and remain its property.

Item c. Checking of Shop Details

Without relieving any contractor (i.e. constructor or supplier of materials, etc.) engaged on the work of any responsibility for the complete discharge of his obligations, the Engineer shall check the contractor's detailed shop or other essential drawings to insure compliance with the specifications and contract drawings.

Item d. Field Inspection of Construction

The Engineer will be responsible for the proper laying out and overseeing of the work, and will provide the complete field engineering and inspection forces required for same, including a competent resident engineer (with necessary assistant engineers and inspectors), who will have immediate charge, under supervision by the Engineer, of the field engineering and inspection work. For construction purposes, the Engineer shall make triangulations and other general surveys, shall establish general lines and bench marks convenient for use by the contractor during construction, and shall check generally the detailed surveys of the contractor in establishing lines and elevations for the construction of detailed parts of the work. The Engineer shall make surveys for the preparation of the data for estimates for payment to the contractor or contractors during construction, and shall determine the quantities and unit prices which shall determine the partial and final estimates for payment to the contractor or contractors.

Item e. Mill and Shop Inspection of Materials

The Engineer shall supervise and direct the field, mill, and fabrication inspection and tests of all materials entering into the work. The Engineer will examine the inspection reports in order to make sure that the quality of material and workmanship complies with the specifications and contract drawings. The Engineer will make no separate charge for these supervising services. The cost of the detailed mill and shop inspections and tests of materials shall be borne directly by the Government.

Item f. Progress and Final Reports

During construction, the Engineer will prepare written reports of progress at regular intervals, and upon completion of the work will make a final report, together with final record drawings showing the actual location of all parts of the work as constructed.

ARTICLE III. EXTRA SERVICES AND SPECIAL CASES

The Engineer will make, without expense to the Government, such revisions of the preliminary plans as he may be called upon to

make to meet the requirements of the Government; but after a definite plan has been approved by the contracting officer, if a decision is subsequently made which, for its proper execution, involves extra services and expenses for changes in or additions to the drawings, specifications or other documents, or if the Engineer is put to labor or expense by delays imposed on him by the Government from causes not within his control or by the delinquency or insolvency of contractors, the Engineer shall be equitably paid for such extra services and expense, which services and expense shall not be considered as covered by the total fee stipulated in this contract.

Should the work or any part of it be abandoned or suspended, the Engineer is to be paid in accordance with the terms of this contract for the proportion of service rendered on account of it up to the time of such abandonment or suspension.

The finding of the contracting officer approved by....., as to what constitutes abandonment of the project or suspension of the work, and as to the amount of service rendered, and the payment to be made therefor, shall be regarded by the parties hereto as final.

ARTICLE IV. TIME OF DOING WORK*

The preliminary plans called for in this contract will be submitted within.....calendar days, following the receipt by the Engineer of notice to proceed.

After approval of the preliminary plans, the contract drawings and specifications for the substructure* contract or contracts will be submitted within.....calendar days of the date of the original notice to proceed; provided, however, that if the preliminary plans are not approved within.....days after their submission, a corresponding delay in the required time for submission of the substructure* drawings and specifications will be allowed.

The Engineer will submit the contract drawings and specifications for the superstructure* contract or contracts within..... calendar days after the original notice to proceed; subject, however, to the same provisions for delay as in the preceding paragraph. Specifications will provide for the prompt submission of shop drawings for structural and reinforcing steel* or of other equipment. These drawings shall be checked by the Engineer within .....working days of their receipt by the Engineer, unless otherwise provided for by the contracting officer.

* *Note: The divisions of the work as noted thus * above are suggestive. Such divisions should be substituted as apply to the various types of work contemplated.*

ARTICLE V. RESPONSIBILITY OF ENGINEER

The Engineer agrees to furnish suitable, adequate, and complete plans and specifications for the work to be done, in conformity with highest quality engineering practice for such work. The Engineer agrees to seek diligently proper execution of the actual construction in accordance with the plans and specifications, and to give adequate and complete supervision of field operations to assure a completed project ready for operation and use to the entire satisfaction of the Government.

ARTICLE VI. PAYMENTS

For and in consideration of the services to be rendered by the Engineer, the Government shall pay and the Engineer shall receive a fee which is determined as a percentage of the actual total construction cost of the work. This percentage fee shall provide compensation to the Engineer for all services set forth in Article I and Article II hereof, except the following items:

1. The Government will assume directly the actual cost of the making of borings, explorations, and laboratory investigations for analysis of same.
2. The Government will assume directly the cost of employing such specialists as may be deemed desirable in connection with the design of special features of the work.
3. The Government will assume directly the cost of all detailed mill, shop, and materials inspections.
4. For field surveys for preliminary investigations and for final design data, the Engineer shall be compensated by the Government on the basis of actual out-of-pocket expense to the Engineer for field forces, plus 25 per cent thereof for overhead, with no allowance for profit or for the services of the Engineer principal.
5. For the services of the resident engineer and his entire field staff, the Engineer shall be compensated on the basis of actual out-of-pocket expense to the Engineer for this entire field staff, plus 25 per cent for overhead, with no allowance for profit or for the services of the Engineer principal.

As compensation for all other services set forth in Article II, the Engineer shall be paid a fee which is.....per cent of the total construction cost of the work; 20 per cent of such estimated fee shall be paid upon the completion and approval of the preliminary studies; an additional 50 per cent of such estimated fee shall be payable upon the submission of contract drawings and specifications for the purpose of receiving bids; an additional 15 per cent of such estimated fee shall be payable when the construction operations are approximately half completed; and the final payment of approximately 15 per cent of such fee shall be paid upon the completion of the work and submission of the final report of the Engineer; the sum of all such payments to represent .....per cent of the actual total construction cost of the work.

ARTICLE VII. TRAVEL EXPENSES

The fee stated in this contract is to cover all traveling expenses between (home office), and (site), and living expenses at the site incurred by the Engineer in the carrying out of the general supervisory services called for in this contract. Should it be necessary under approval of the contracting officer for the Engineer to go to points other than the site, the Engineer is to be reimbursed for traveling expenses therewith, and the living expenses while away, such reimbursements for living expenses not to exceed $..... per day.

ARTICLE VIII. EXTRA COPIES OF BLUEPRINTS AND SPECIFICATIONS

The Engineer will furnish as many blueprint copies of plans, and mimeographed copies of specifications, as may be required for the use of prospective bidders, for which he shall receive reimbursement of actual out-of-pocket expense.

ARTICLE IX. TERMINATION OF CONTRACT BEFORE FINAL COMPLETION

If the conduct of the Engineer is such that, in the opinion of the contracting officer, the interests of Government are thereby likely to be placed in jeopardy, or if the Engineer violates any of the conditions or stipulations of this contract, the contracting officer, acting for and in behalf of the Government, and with prior approval of....., shall thereupon have the right to terminate this contract by giving notice in writing of the fact and date of such termination to the Engineer, in which event all drawings, etc., which have been presented for the approval of the Government shall become the property of the Government; providing in such case, however, that the Engineer shall receive equitable compensation for such services as, in the opinion of the contracting officer, shall have been satisfactorily performed by him up to the date of the termination of said contract; such compensation to be fixed by the contracting officers upon the basis of the percentage of services completed.

The sole purpose of this Article is to assure adequate and competent service to the Government on the part of the Engineer.

ARTICLE X. ALTERNATE DESIGNS

Compensation under this contract does not contemplate the preparation of designs, plans, and specifications for alternate structures.

ARTICLE XI. EXCLUSION OF PUBLIC OFFICERS FROM BENEFITS OF CONTRACTS

It is an expressed condition of this contract that no member of, or delegate to Congress, or resident commissioner or other public officer whose name is not at this time disclosed, shall be admitted to any share in this contract or to any benefit to arise therefrom, and it is further convenanted and agreed that this contract shall not be assigned.

ARTICLE XII. GUARANTEE THAT NO COMMISSIONS WERE PAID TO SECURE CONTRACT

The Engineer warrants that he has not employed any person to solicit or secure this contract upon any agreement for a commission,

percentage, brokerage, or contingent fee. The breach of this warranty shall give the Government the right to annul the contract, or in its discretion to deduct from the contract price or consideration the amount of such commission, percentage, brokerage, or contingent fees.

ARTICLE XIII. PATENTS

There will be no charge to the Government for any patent rights which are controlled by the Engineer and which may be involved in the construction and operation of this project. The Engineer shall endeavor to advise the Government of any process or patent rights which are not held or controlled by the Engineer, which, in the opinion of the Engineer, may be involved in the construction and/or operation of this project where the responsibility for such process or patent rights is not made an obligation of the contractor for construction.

ARTICLE XIV. EMPLOYEES AND SALARIES

The Engineer agrees to employ competent assistants, such assistants to hold State licenses as professional engineers where such licenses are required for the positions occupied; and to compensate all employees in accord with a schedule of salaries which shall be filed with the Contracting Officer previous to the execution of this agreement, which schedule of salaries shall be adhered to by the engineer throughout the duration of this project.

Note: The Schedule of Salaries to be filed with the Contracting Officer should conform generally to the Report on Prevailing Salaries of Civil Engineers adopted by the Board of Direction of the American Society of Civil Engineers, July 10, 1934.

ARTICLE XV. APPROVAL

This contract shall be subject to the written approval of ....., and shall not be binding until so approved.

In Witness Whereof, the parties hereto have executed this contract as of the day and year first above written.

THE UNITED STATES OF AMERICA

By_____

(*Name*)

By_____

Witnesses:

_____

_____

Approved:

Note: See "Recommendations for Determining Fees to Be Allowed for Professional Engineering Services on Federal and Federal-Aid Projects Undertaken as an Aid to Industrial Recovery or Relief of Unemployment," prepared by the Committee on Fees, E. R. Needles, chairman, and approved by the Board of Direction of the Society, April 3, 1935; and report on "Salaries of Civil Engineers," prepared by the Committee on Salaries, Ernest P. Goodrich, chairman; and approved by the Board of Direction of the Society, July 10, 1934.

Engineers Sponsor Development Program for Young Graduates

Committee of E.C.P.D. Offers Method of Self-Appraisal as Basis for Post-College Training

WHEN DOES an engineer's education end? With his graduation from college? Or is further self-development necessary to enable the junior engineer to take responsible charge of engineering work, become a valuable member of society, and gain professional recognition?

In the opinion of the Engineers' Council for Professional Development (E.C.P.D.), the years immediately after graduation from an engineering school are not only fruitful years for growth and development, but critical years in the young graduate's progress toward the goal of public recognition as a full-fledged engineer. It is the function of the Council's Committee on Professional Training to offer a program for further intellectual development that will bridge this gap between graduation, or its equivalent, and professional recognition.

The program of E.C.P.D. is embodied in the work of four major committees dealing with the selection and guidance of prospective engineering students, the accrediting of engineering schools worthy of recognition, the further professional and personal development of junior engineers, and the formulation of minimum standards for professional recognition. Information regarding the Council and the activities of its committees may be obtained from the secretary, 29 West 39th Street, New York, N.Y.

General Robert I. Rees, assistant vice-president of the American Telephone and Telegraph Company and chairman of the Council's Committee on Professional Training, recently outlined the Council's program for junior engineers. "It is incumbent upon us," he said, "to prepare sound programs for the guidance of the intellectual development of the young engineer after he gets into practice. It is particularly important to stimulate his growth in cultural, social, and economic subjects, for the study of which his college course necessarily left little time."

As a first aid to junior engineers, General Rees's committee has prepared a personal appraisal questionnaire that offers opportunity for a searching self-analysis of the individual's status. If the young graduate will thoughtfully and honestly answer the 65 questions in the appraisal regarding his present occupation, his professional status, his personal relations, and his general program of development, he himself should be able to outline an immediate plan of study based on his individual strength and weakness, his background and ambition. "The early years of a young engineer's life present a sharp challenge to his progress," says General Rees. "To an unusual degree the pace of his personal, social, and intellectual development at this time depends upon himself." And it is to aid in this development that the personal appraisal has been prepared as a guide to future action.

A related activity of the Committee on Professional Training is the preparation of a reading list for junior engineers who are desirous of broadening their horizons and developing a full professional life. The list covers natural science, philosophy, economics and sociology, psychology, business and industrial management, literature, history, biography and travel, and the fine arts. The committee estimates that over a period of about four years a minimum of 25 of these books can be read, with the limiting recommendation that the selection include at least one book in each classification. A pamphlet entitled *Suggestions to Junior Engineers* and containing both the questionnaire and the reading list may be obtained from the secretary of the E.C.P.D., 29 West 39th Street, New York, N.Y., at a charge of 10 cents per copy. Earlier forms of these two items appeared in the May 1934 issue and in the June and December 1934 issues of CIVIL ENGINEERING, respectively.

In executing its program, the Committee on Professional Training has enlisted the cooperation of the divisions, local sections, student branches, and individual members of the participating societies of the Engineers' Council for Professional Development. The aim is to make it possible for a junior engineer to confer regarding his career with mature engineers, either personally or by correspondence, and to get a satisfactory answer to the question: What must an engineer know and what must he be able to do?

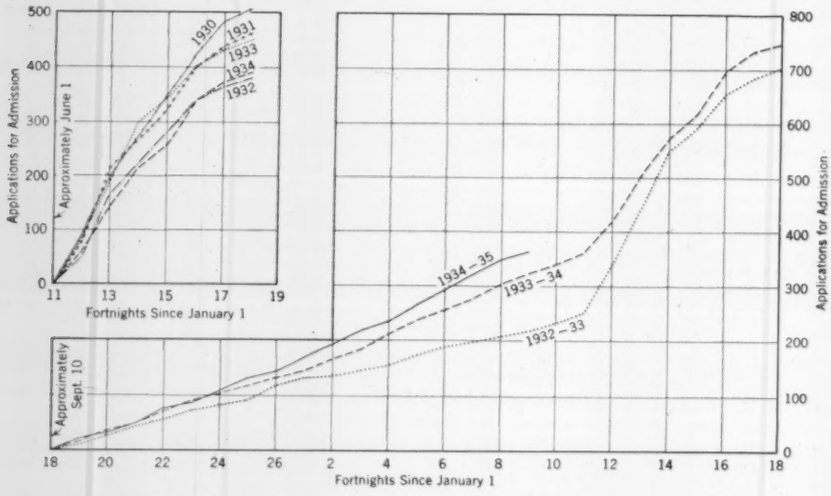
Registration Law Goes Into Effect in New Mexico

A PROGRAM for the benefit of the entire profession in the state has been undertaken by the New Mexico Section of the Society. One item on this program was a drive to secure the enactment of a registration law for engineers and surveyors comparable with those now in force in other states. This objective has been achieved and the law went into effect on May 22, 1935.

Another part of this program is the maintenance of an employment service. Any engineer, regardless of his field of practice, desiring to secure a position may register with E. L. Barrows, Assoc. M. Am. Soc. C.E., U. S. Geological Survey, Santa Fe, N.Mex., chairman of the Section's employment service. Through him registrants will be assisted in getting into communication with prospective employers.

Applications for Membership Increase for Second Successive Year

APPLICATIONS for membership in the Society are coming in at an increasing rate, as indicated graphically in Figs. 1 and 2. In Fig. 1 a comparison is made of the number of applications received during the terms 1932–1933, 1933–1934, and 1934–1935, plotted cumulatively at two-week intervals. The origin is taken at about September 10 each year, which has been found to be the seasonal date when the most uniform number is received and when the influence of the surge of applications from recent graduates of engineering colleges ceases to be felt. By this method the total effect of the summer influx is shown at the right-hand end of the curve.



APPLICATIONS RECEIVED, BY FORTNIGHTS NUMBERED FROM JANUARY 1
Fig. 1. By Terms; Fig. 2 (at Upper Left) Summer Influx

To indicate how remarkably uniform is this summer influx, curves have been prepared for the past five summers, as shown in Fig. 2. For comparative purposes, the origin of this diagram was taken at about June 1. Two more years might have been plotted, except that 1928 practically coincided with 1930 and 1929 with 1934.

The count of applications does not differentiate between grades, since the actual appropriate grades are not known until the Board of Direction takes final action. Nevertheless the summer influx can be assumed to consist mostly of junior applications. It is distinctly encouraging to find that the youngest members of the profession, those just graduating from college, value membership so highly that even in years of depression they start at once to ally themselves with the Society.

The rate at which applications come in for membership is a fair indication of the relative economic condition of civil engineers, since men do not ordinarily seek membership unless they feel that they can afford to pay the dues. No attempt to find an exact correlation has been made, but for the last eight years the Society has been counting up the number of applications each week and plotting them on a chart each fortnight.

Prospects for the future look definitely heartening. Referring to Fig. 1 for the most recent point on the curves, the number of applications for the first week in May is found to be about half that of the average of 1928, 1929, and 1930 for the same period. This is a very encouraging advance over the number received in May 1933, which was only about one-third of this average.

New Student Chapter Comes Into Existence at Dartmouth

FOLLOWING the April meeting of the Board of Direction at Miami, the one hundred and eleventh Student Chapter of the Society came into existence at the Thayer School of Civil Engineering, Dartmouth College, Hanover, N.H. The new Chapter, with an initial membership of 18, will be known as the Dartmouth College (Thayer School of Civil Engineering) Student Chapter and will have as its adviser Frank W. Garran, M. Am. Soc. C.E.

The Thayer School was founded in 1871 by General Sylvanus Thayer, who had made a notable record as commandant at West Point and wished to establish an institution for training civil engineers on the same broad principles he had used at the military academy. He selected young Robert Fletcher, then a lieutenant just out of West Point, and sent him to Dartmouth College to start the school. Robert Fletcher, who today heads the list of members having the longest connection with the Society, and is Director Emeritus of the school, takes a great interest in the new Chapter.

In welcoming the newest student organization, the Society hopes that the Dartmouth College Chapter will find and develop as many fine qualities in its members and opportunities in its activities as have been found in other Chapters.

Metropolitan Student Chapters Meet

ON THE evening of May 3, 1935, eight Student Chapters of the New York Metropolitan district met in conference in the Engineering Societies Building. About 150 students attended, from the participating institutions of the College of the City of New York, Brooklyn Polytechnic Institute, Newark College of Engineering, Columbia University, New York University, Manhattan College, Rutgers University, and Cooper Union.

The student members and their guests were welcomed by A. C. Osterlund, of Newark College of Engineering, vice-chairman of the conference for the current year. He introduced Arthur S. Tuttle, President of the Society, who expressed pleasure at the growing number of student conferences and pointed out the advantages to be gained by early and definite affiliation with the profession. Allen P. Richmond, Jr., Assistant to the Secretary of the Society, complimented the executive committee of the conference on its fine work in connection with committee meetings. Carlton S. Proctor, M. Am. Soc. C.E., explained the principles applied by the committee appointed to judge of composition in selecting the four papers to be presented at the conference.

The student paper prize competition then got under way, with Alexander Haring and D. B. Steinman, Members Am. Soc. C.E., and Prof. Gustave Schulz, of the College of the City of New York, acting as judges. Walter Gray, of the College of the City of New York, won first prize with a paper on "Camera Surveying at Van Cortland Park, New York City." Second prize was awarded to John Buffa, of Brooklyn Polytechnic Institute, who spoke on "Photo-Elastic Stress Analysis."

Memoirs of Deceased Members

SINCE the May issue went to press the Society has printed 14 more memoirs of deceased members. Characteristic of engineering accomplishment in the era which these men represent is the construction and maintenance of railroads and the early development of electric power, electric traction, and street-car transportation. Much intimate first-hand knowledge of the development and construction of the rapid transit system of the city of New York becomes a closed book with their passing.

Concentrated in the composite experience of this small group of men is the engineering development and irrigation of the Northwest, power development in all parts of the United States, the improvement of rivers and harbors and especially of the ports along the Pacific Ocean, notable work in the prosecution of the World War, and the design and construction of dams and port facilities. Among them are graduates of West Point and Annapolis, who had brilliant careers in the U. S. Army Corps of Engineers and the U. S. Navy. One of them worked with Thomas A. Edison. Another was largely responsible for the introduction of a standard

system of measurements, which permitted the accurate interchangeability of machine parts and opened the door to our present system of mass production in industry. Teachers of engineering are represented, as are also eye-witnesses and students of the St. Louis tornado of 1896, which afforded to designers of buildings one of the earliest opportunities to obtain precise knowledge of wind stresses.

A limited number of reprints is available for free distribution. The list of these 14 memoirs follows:

Julius Baier	1863–1905
George Meade Bond	1852–1935
George Bryan, Jr.	1886–1934
Edward Morris Burd	1887–1934
James Hopkins Clark	1882–1934
John Wendell Hall	1885–1934
William Campbell Langfitt	1860–1934
Archibald McLean	1856–1935
Edward Charles Murphy	1859–1934
Francis Joseph O'Hara	1876–1934
Charles Penrose Perkins	1844–1934
William Bancroft Potter	1863–1934
James Ritchie	1856–1934
Frank Julian Sprague	1857–1934

Colorado Junior Association Completes Successful Year

WITH the May-June meeting, the Junior Association of the Colorado Section officially closes its first year. This body was organized in the late summer of 1934 from among the junior members of the Colorado Section for the purpose of awakening interest among young engineers and giving them an opportunity for expansion and practice in public speaking before their own group. Frank B. Campbell, Jun. Am. Soc. C.E., was very active in arousing enthusiasm for the movement. The organization committee was composed of Clarence Rawhouser, chairman, and J. W. Courter, E. W. De Berard, J. B. Drisko, J. S. Hamilton, and H. J. Tebow, all Juniors of the Society.

The Junior Association holds at least five meetings each season, on the fourth Monday of the month, and in addition conducts two of the Colorado Section's regular monthly meetings. The Association's meetings have been uniformly successful, including several inspection trips to points of interest. The attendance of Juniors at the meetings of the Local Section has also improved from an average of six to that of 35, due to the renewed interest in engineering matters among the younger members. The original directing committee of the association consisted of H. J. Tebow, chairman, and J. W. Courter and J. S. Hamilton. F. C. Hart was elected to the directing committee in November 1934. O. C. Reedy has served as secretary for the past year. All are Juniors of the Society. This information regarding the Colorado Junior Association has been made available by Mr. Courter.

Personal Records in Society Files to Be Brought Up to Date

ON MAY 15, two forms were mailed from Society Headquarters to all members—one to contain biographical and personal records for the classified file and the other a questionnaire to be filled out in anticipation of the demand for engineers on the federal work relief program. Civil engineers are particularly adapted to perform the functions of design and administration that will be essential to the work.

The Society's regular biographical and professional record form should be filled in and returned by every member so as to make as complete as possible the Society's classified file for use in regular as well as in emergency employment operations.

The questionnaire form should be filled in and returned by every member not now suitably employed, in accordance with the following conditions. At the top of the questionnaire appears the question, "Are you available for personal engagement?" It is not intended that this question shall be answered "Yes" by those who are engaged in regularly established engineering organizations. It is especially directed to the determination of the qualifications of those who, because of the depression, are misplaced or without engagement, and thus are immediately available for some position, possibly temporary, where their special qualifications would be desired.

Those who answer "Yes" should fill in the questionnaire and return it, together with the biographical and professional record form, also filled in completely. Any member who has not received the forms referred to should communicate with Society headquarters.

Local Sections to Name Employment Correspondents

APPOINTMENT of members to act as personal correspondents handling information in connection with employment of engineers on federal government relief work was requested in a letter dated May 14, 1935, addressed to presidents and secretaries of Local Sections.

It appears that opportunities for engineers are likely to be developed in this work either directly through the Society or through the very active efforts now being made by the American Engineering Council.

Without question, speed will be a dominating characteristic of any successful efforts to be of service and to accomplish results in this situation. It is therefore proposed that there be developed a group of individual engineers to act as personal correspondents, to whom information can be directly transmitted, and who will have the opportunity, time, vigor, and willingness to apply it locally without delay.

This procedure will also be undertaken by the other Founder Societies. Those civil engineers who undertake the work in each particular locality will be advised of the similar representatives from the mechanical, electrical, and mining engineering societies, in order that there may be a coordinated effort with as little crossing of wires as possible.

Society Appointees

GEORGE E. BEGGS, M. Am. Soc. C.E., has accepted a reappointment to serve as a Society representative on the Engineering Foundation for the four-year term, October 1935 to October 1939.

RALPH R. PROCTOR, M. Am. Soc. C.E., has been appointed an additional member of the Society's Committee on Earths and Foundations.

News of Local Sections

BUFFALO SECTION

At a luncheon meeting of the Buffalo Section, held on April 2, the following officers were elected for the current year: Arthur Skaer, president; William P. Feeley, vice-president; and Stewart S. Neff, secretary-treasurer. After the business session the newly elected president gave an interesting talk on the development of flat-slab concrete construction in the United States. There were 15 members present.

CENTRAL OHIO SECTION

On March 14 a luncheon meeting of the Central Ohio Section was held in Columbus. Several committee reports were discussed, and various business matters were attended to. Then the guest speaker, Prof. Harold W. Bibber, spoke on "Structural Design in Countries Subject to Earthquakes." There were 28 members and guests present. On April 18 a luncheon meeting of the Section was held, with 26 in attendance. At this session an illustrated talk on the State Office Building explosion was given by Prof. James R. Withrow.

CLEVELAND SECTION

Numerous business matters were discussed at a meeting of the Cleveland Section held at the Chamber of Commerce Club on April 2. The report of the Welfare and Employment Committee was heard, and this indicated that the unemployment situation in the Section is not as serious as might have been supposed. This conclusion was based on the fact that, in response to 200 inquiries regarding the employment status of engineers, only 20 replies were received. The speaker of the occasion was E. M. Thum, editor of *Metal Progress*, who addressed the gathering on the subject of stainless steel, stressing particularly its use in the building industry.

COLORADO SECTION

There were 48 present at a meeting of the Colorado Section held in Denver on April 8. Several committees were appointed, and announcements were read. Then the meeting was turned over to D. D. Gross, chief engineer of the Board of Water Commissioners, who gave a description of the present status of work on the project to bring water through the Moffat Tunnel from the Fraser River, Jim Creek, and Vasquez Creek. He also gave a résumé of current conditions in regard to the city's water supply. He was assisted in his presentation by Mr. Matthews, special engineer, Mr. Schneider, designing engineer, and Mr. Potts, hydraulic engineer, for the board.

The Association of Junior Engineers of the Colorado Section held a meeting on March 25, with 27 present. Several announcements were made and plans for future meetings were discussed. Then a symposium on the subject, "The Early Years of Modern Civil Engineering" was presented by four speakers—I. K. Silverman, A. R. Golzé, O. C. Reedy, and J. W. Courter—who developed this theme by reference to the various fields of engineering. There were 29 present at a meeting of the association held on April 22. Reports on recent social and engineering activities of the association were given by R. H. Summer, assistant manager of the Denver district of the Du Pont Powder Company, and F. E. Jacquot, manager of the Du Pont plant at Louviers, Colo.

CONNECTICUT SECTION

Members of the Yale University Student Chapter were guests of the Connecticut Section at a dinner meeting held in New Haven on April 25. Frank A. Barbour, Director of the Society, attended this gathering and spoke on the Society. The main address was given by O. H. Ammann, chief engineer of the Port of New York Authority, who discussed the Tri-borough Bridge Project in New York City.

DAYTON SECTION

A special program was arranged for the April 29 meeting of the Dayton Section. Through the courtesy of the American Rolling Mills Company the members and guests of the Section were given an opportunity to inspect a frameless steel house recently erected by the Armco Company at Middletown, Ohio. At the conclusion of the inspection trip dinner was served at the Manchester Hotel, and then the group was conducted through the mills of the Armco Company. This trip is very spectacular, especially when made at night, and was thoroughly enjoyed by all. The attendance of 64 included members of the University of Dayton and Antioch College Student Chapters.

DISTRICT OF COLUMBIA SECTION

On May 1 almost 500 members and guests of the District of Columbia Section inspected the new Supreme Court Building in Washington. Groups were conducted through the building by guides under the personal supervision of Gratz B. Strickler, superintendent of construction on the project; Theodore Irving Coe, representing the architects for the building; and Frank E. Warren, representing the contractors. Inspection of the air-conditioning equipment was made under the guidance of S. B. Eagleton, of the staff of the architect of the Capitol, and representatives of the Carrier Engineering Corporation.

KANSAS STATE SECTION

There were 28 in attendance at a meeting of the Kansas State Section held at the Hotel Kansan in Topeka on April 19. Members of the University of Kansas and Kansas State College Student Chapters were introduced to the Section. The feature of the occasion was a talk by George S. Knapp, of the Division of Water Resources of Kansas, who spoke on the current situation in regard to water resources.

LOS ANGELES SECTION

The regular monthly meeting of the Los Angeles Section was held on April 10 at the University Club, with 145 in attendance at both the meeting and the dinner preceding it. The program at this time included an illustrated lecture given by Paul Baumann, assistant chief engineer of the Los Angeles County Flood Control District, who showed slides of check dams. The Mono Basin Project was then described by H. A. Van Norman, chief engineer and general manager of the Bureau of Water Works and Supply of the City of Los Angeles. The relation of this project to Owens Basin, the present source of water supply, was also considered.

LOUISIANA SECTION

A meeting of the Louisiana Section was held at the St. Charles Hotel in New Orleans on April 8, with 106 members and guests present. The technical exercises consisted of an interesting address on the subject, "Mapping Louisiana from the Air," given by John Paul Dean, Captain, Corps of Engineers, U. S. Army. This talk, which was illustrated with numerous maps and slides, proved very enjoyable.

MARYLAND SECTION

Numerous meetings have been held by the Maryland Section during recent weeks. On March 8, a well-attended meeting was addressed by Roy M. Dorcas, associate professor of psychology at Johns Hopkins University, who spoke on the subject of hypnotism. On March 21, a joint meeting, with the Engineers' Club and other affiliated organizations, was held at the headquarters of the club. A lecture, illustrated by stereopticon slides and five reels of motion pictures, was given by W. M. Price, of the Bethlehem Steel Company. The subject of this address was the Boulder Dam Project. On March 27 and 28, the Section had a visit from Walter E. Jessup, Field Secretary of the Society. A number of members met Mr. Jessup at luncheon on the 28th, and afterwards a round-table discussion on various matters of interest to the Society was held. On April 5, J. V. B. Duer, electrical engineer of the Pennsylvania Railroad, addressed the Section, the Engineers' Club, various affiliated societies, and the Maryland Academy of Science on the electrification of the Pennsylvania Railroad. On April 6, through the courtesy of this railroad, an inspection trip was made to view the various local improvements recently constructed by the railroad.

METROPOLITAN SECTION

On May 15 the Metropolitan Section held a meeting in the Engineering Societies Building in New York, with Ole Singstad, retiring president, as chairman. Announcement was made of a dinner to be held by the Junior members and new officers for the following year were installed. These are Van Tuyl Boughton, president; E. M. Van Norden, vice-president; and J. S. Langthorn, treasurer. The topic to be discussed was airport facilities of the port of New York, and the principal address of the evening was made by Lyle Boulware, superintendent of architecture for airports. In addition to Floyd Bennett Field, located on the southern extremity of Long Island, two additional landing fields are now planned or in process of construction, one at North Beach, L.I., and the other on Governors Island. Ramps in the East River at the foot of Wall Street and of 31st Street give access to seaplanes for 7-minute service to Floyd Bennett Field, and also to a sheltered landing place for private planes. A feature of these ramps is the provision of automatic turntables for the positioning of planes. More than 150 members heard the talk, which was illustrated with lantern slides and moving pictures.

NORTH CAROLINA SECTION

At the annual meeting of the North Carolina Section, held on April 25 and 26, the following officers were elected for the ensuing year: Leslie R. Ames, president; D. S. Abell, vice-president for one year; B. W. Davis, vice-president for two years; and Harold C. Bird, secretary-treasurer.

NORTHWESTERN SECTION

The Northwestern Section recently held a testimonial dinner to celebrate the recent election of William L. Darling to honorary membership in the Society, and to express the appreciation of the

Section for Mr. Darling's many services to the profession and to the public. Several of Mr. Darling's associates spoke, and congratulatory letters and telegrams from engineers in all parts of the country were read.

OKLAHOMA SECTION

A symposium on the "Chemical-Mechanical Treatment of Sewage" was presented at a meeting of the Oklahoma Section held on April 27. A paper on this subject was read by L. H. Scott; some chemical demonstrations were made; and slides and motion pictures of the application of this method at the North Side Sewage Disposal Plant in Oklahoma City, Okla., were shown. All present then took part in a general discussion of this subject.

PANAMA SECTION

A meeting of the Panama Section was held at the Miramar Club in Panama City on April 9. The feature of the occasion was the presentation of a symposium on the proposed inter-continental highway. Those participating were E. W. James, chief of the Division of Highway Transport, U. S. Bureau of Public Roads; Tucker Brown, senior highway engineer, U. S. Bureau of Public Roads; and George Curtis Peck, of the U. S. Department of Commerce. Refreshments were enjoyed at the conclusion of the meeting.

PHILADELPHIA SECTION

On March 20 the Philadelphia Section held a meeting in the Franklin Institute museum. There were 44 at the dinner preceding the meeting, and 81 took part in the tour through the museum under the direction of experienced guides. The first stop was in the observatory, where the members viewed through telescopes the nebula in Orion and an interesting double star. Other important features of the museum were also inspected, and some of the members attended a lecture in the planetarium. At the meeting of the Section held on April 17, R. L. Bertin, chief engineer of the White Construction Company, gave an interesting illustrated talk on the construction of the dome of the planetarium at the American Museum of Natural History in New York. The greater part of the evening was given over to Student Chapter members, who presented a program of entertainment. It was announced that H. L. Redmile, of the University of Delaware, was the winner of the technical paper contest held that afternoon at the University of Delaware. He was awarded the cash prize of $20.

PROVIDENCE SECTION

A joint meeting of the Providence Section and the Providence Engineering Society was held on April 18, with 75 members and guests in attendance. The principal speaker was L. E. Andrews, regional highway engineer of the Portland Cement Association, whose subject was "New Developments in Highway Engineering, Planning, and Design." An animated discussion of the problems involved in the design of cement highways followed.

SACRAMENTO SECTION

Weekly meetings have recently been held by the Sacramento Section. On April 2, the speaker was E. A. Abeel, California State Civil Service examiner. There were 24 present at this session. On April 9, a business session was held, with 33 members and 15 guests in attendance. The speaker on this occasion was H. D. Stover, bridge engineer of the California Division of Highways. On April 16, the speaker was H. A. Young, professor of chemistry at the University of California, who gave an illustrated lecture on molecular chemistry. On April 23, several business matters were attended to, and a talk was given by Donald R. Warren, senior bridge field engineer, of the California Division of Highways. This was greatly enjoyed by the 39 members and 18 guests present. On April 30, the speaker was Thomas Stanton, materials and research engineer, of the California State Department of Public Works.

SAN DIEGO SECTION

There was a large attendance at the dinner meeting of the San Diego Section held at the Churchill Hotel on March 29. The feature of the evening was a talk by Franklin Thomas, professor of civil engineering at the California Institute of Technology and a director of the Metropolitan Water District of Southern California. Professor Thomas described the construction methods in use on the Colorado River Aqueduct and showed two reels of motion pictures of work on the various sections of the aqueduct.

SAN FRANCISCO SECTION

A meeting of the San Francisco Section was held at the Engineers' Club on April 16, with 139 members and guests present. After the presentation of a program of entertainment by the University of California Student Chapter, a business session was held. Several committee reports were read, and various resolutions were adopted. A feature of the technical meeting was a talk by J. Hugh Jackson, dean of Stanford University, who spoke on the subject, "Business in Retrospect and Prospect."

SPOKANE SECTION

The Spokane Section and Associated Engineers of Spokane held a joint luncheon meeting on April 3. Among the hundred members and guests present were representatives from the University of Idaho and Washington State College Student Chapters. The speaker of the occasion was R. J. Jenks, a member of the engineering staff of the Mason-Walsh-Atkinson-Kier Company, who discussed the construction of the Grand Coulee Dam.

ST. LOUIS SECTION

There were 37 members and guests in attendance at a luncheon meeting of the St. Louis Section held at the Mayfair Hotel on April 22. Numerous business matters were discussed at this session, and plans were made for future meetings. Then S. M. Smith, of the Bridge Department of the Wabash Railroad, gave an interesting talk on the construction and design of the Wabash Railroad Bridge across the Missouri River at St. Charles.

TEXAS SECTION

The spring meeting of the Texas Section was called to order at the Navarro Hotel in Corsicana, Tex., on May 3. The morning session was devoted to opening exercises and an address by Victor H. Schoffelmayor, agricultural editor of the *Dallas News*, who spoke on "Industrial Progress in Continental Europe, with Emphasis on Russia." After luncheon at the Navarro Hotel the membership was taken on an inspection trip to the Corsicana plant of the American Well and Prospecting Company. Then a paper on "National Forestry in Texas" was presented by L. L. Bishop, forest supervisor of the Sam Houston National Forest, in Houston, Tex. A discussion of this paper followed, and then Walter E. Jessup, Field Secretary of the Society, discussed with the membership the possibilities of increasing the usefulness of the Society to the Local Sections. A dinner dance was enjoyed in the evening. On Saturday morning a business session followed the presentation of a paper on "A Program for the Prevention and Control of Soil Erosion as Applied on the Elm Creek Watershed of the Soil Erosion Service," by H. O. Hill, chief engineer of the Soil Erosion Service, Temple, Tex. At noon the group was conducted to the plant of the Texas Power and Light Company at Trinidad, Tex., where they were guests of the company at a barbecue. In the afternoon they were conducted on an inspection trip of the plant. The total registration for the meeting was 110.

VIRGINIA SECTION

A two-day spring meeting of the Virginia Section was held in Norfolk, Va., on April 26 and 27 in conjunction with sessions of the Engineers' Club of Hampton Roads and the Virginia sections of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers. Members of the several societies assembled at the Monticello Hotel on Friday morning and had their several business meetings. Later the various groups met together to enjoy a technical program. Papers were presented by C. D. Waldron, a physicist, who spoke on Diesel engines, and M. G. Munce, who discussed the principles of air conditioning. In the afternoon an inspection trip was made to the Ford motor assembly plant, and special entertainment was provided for the ladies. A dinner was held in the evening at the Monticello Hotel. The program of entertainment at this function included a talk by H. C. Griffith, assistant electrical engineer of the Pennsylvania Railroad Company, and an illustrated lecture on astronomy, given by R. G. DeFrees. On Saturday an all-day excursion to various points of historic and scenic interest was enjoyed. Among the places visited were the Mariners Museum at Newport News and William and Mary College at Williamsburg.

ITEMS OF INTEREST

Engineering Events in Brief

CIVIL ENGINEERING for July

AMONG the articles scheduled for the July number of CIVIL ENGINEERING is one by James P. Growdon, M. Am. Soc. C.E., chief hydraulic engineer, Aluminum Company of America, on that company's hydro-electric developments on the Little Tennessee River. The company's three plants, located about 50 miles above the mouth of the river in the foothills of the Great Smoky mountains, supply power to its Alcoa works, near Maryville, Tenn. Pioneering solutions to local problems arising in the construction of each of the dams make Mr. Growdon's article of interest. For example, in the case of the Calderwood Dam, built in 1930, the use of a V-shaped deflector at the bottom of the stilling pool, developed by model tests, was found to double the effective depth of the pool.

In a paper on "Urgent Problems in City Development," Thomas Buckley, M. Am. Soc. C.E., assistant chief engineer and surveyor, City of Philadelphia, emphasizes the need for sensible, dependable city planning, designed rather for the present than for future needs. Present unsettled economic conditions have added an element of uncertainty in estimating municipal resources, and it is recommended that planning activities be directed to such things as zoning, control of growth, and studies of industrial trends rather than to costly reconstruction projects. Mr. Buckley's article is well illustrated with views of recent Philadelphia improvements, including changes of highway grades, and railroad and highway grade separations. An unusually well-proportioned arch highway bridge is the subject of one photograph. Other illustrations contrast the pretentious fronts of residences with their unattractive rears, indicating that there is plenty of room for improvement in the building of private homes as well as in public work.

An excellent article on the subject of "Research as Applied to Engineering" is contributed by Earle B. Norris, M. Am. Soc. C.E., dean of engineering at Virginia Polytechnic Institute. Professor Norris first points out the close relationship between science and engineering. The engineer has in many cases burst his bonds as a mere technician and is advancing to take his place in some measure as a scientist with keen appreciation of human needs. Research is looked to by many as the saving power which will lead us out of the present economic crisis by putting some invention, such as air-conditioning, on a commercial basis. In any event it can be demonstrated that the investments of industry in research can and do pay dividends. Mr. Norris' paper closes with an account of some valuable discoveries in industrial research made in the laboratory of a southern college.

The subject of "Coordinating Automobile and Highway Design" is discussed in a short but timely article by John W. Wheeler, M. Am. Soc. C.E., member of the Indiana State Highway Commission. Instead of building roads for faster cars, Mr. Wheeler favors limiting their speed.

Recording Earthquake Motions

A RECENT bulletin from the U. S. Coast and Geodetic Survey describes government seismographic records of California earthquakes. These measurements are important not only to pure science but also as a measure of the probable forces active in building failures. The increased wave effects near the tops of buildings, due to resonance, are also measured. In selecting the site for the new San Francisco mint, the Treasury Department made a study of strong motion records and also tested similar effects on the proposed site for the new building by means of traffic vibrations, vibration machines, and blasting.

Hitherto unpublished results of the earthquake occurring in southern California on June 7, 1934, indicate a maximum horizontal acceleration of 4 cm per sec per sec. The epicenter of the quake was 100 to 175 miles distant from the three accelerographs located at Santa Barbara, Hollywood, and Pasadena, respectively. A second shock, occurring in California on March 3, 1935, was centered at a point off the coast near Eureka, and developed a maximum recorded horizontal acceleration of 5 cm per sec per sec.

Society of Photogrammetry Meets

AT THE 1935 annual meeting of the American Society of Photogrammetry held in Washington April 22 and 23, papers were presented describing commercial aerial photography, new instruments and methods, Federal photomapping projects, and the teaching of photogrammetry in the universities.

This society was formed on August 14, 1934, with the following provisional officers: C. H. Birdseye, M. Am. Soc. C. E., president; J. W. Bagley, first vice-president; O. S. Reading, second vice-president; J. W. Ninneman, secretary; M. S. Wright, treasurer. The purpose of the society is to provide adequate detailed mapping information about modern methods of aerial photography and photomapping.

The following interesting remarks are taken from a statement by one of the members of the society.

"In the third century before Christ, Eratosthenes surveyed the distance between two cities on the same meridian and calculated the polar diameter of the earth to be within 50 miles of the value now accepted. Down through the ages Heron played with his steam engine, the Arabs with trigonometry, and Galileo dropped his famous cannon balls from the leaning tower of Pisa. Although the record of their work has been preserved, most of these ancient workers played a lone hand, and the results of their work came into use very slowly. Modern science really got under way only a few centuries ago when the invention of movable type and the development of printing made it practicable to give a wide circulation to detailed information. Where the ancients numbered their scientific men by ten, there are now tens of thousands. Thus the last hundred years have shown more progress than all the rest of history. National and international groups have been organized for the comparison of data, the exchange and criticism of ideas, and the planning of future researches."

Engineers to Measure Height of Stratosphere Balloon

IOWA ENGINEERS will have a part in the stratosphere balloon flight to be attempted in June by the National Geographic Society and the U. S. Army near Rapid City, S.D. It is planned to station ten observers at intervals of 30 miles in southwestern Iowa along triangulation lines of the U. S. Coast and Geodetic Survey for the purpose of measuring the height of the balloon with surveying instruments.

These observations will be made simultaneously at the various stations from which the balloon can be seen, upon receipt of signals by radio operators stationed near the engineers. R. S. Patton, M. Am. Soc. C.E., Director of the U. S. Coast and Geodetic Survey, has requested J. S. Dodds, M. Am. Soc. C.E., Professor of Civil Engineering at Iowa State College, to enlist the services of both Iowa and Missouri engineers and radio operators. The observations will be made when the balloon has reached an approximate elevation of 28,000 ft, after which an attempt will be made to reach a maximum height, probably 13 miles or more.

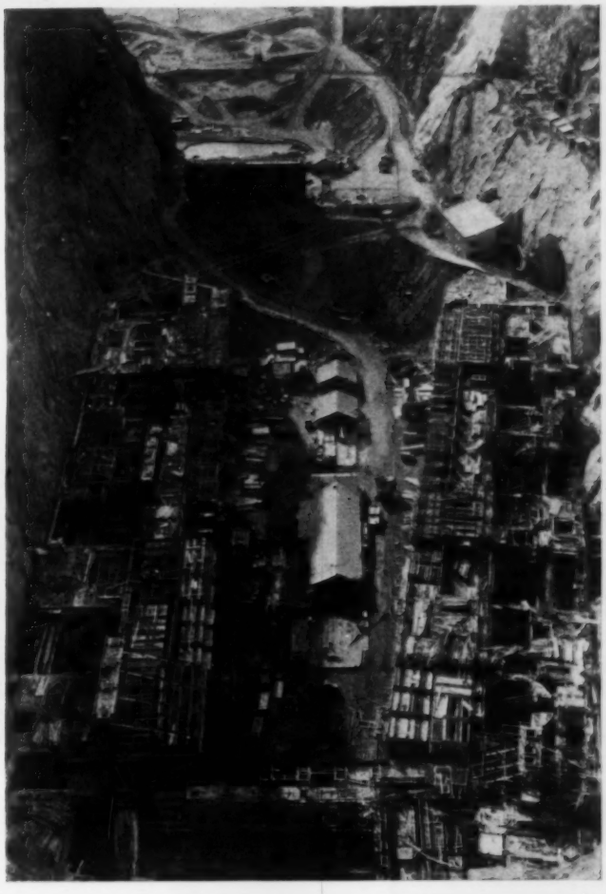
Present plans for the flight provide for the largest free-gas balloon ever constructed, having a capacity of 3,700,000 cu ft of gas. The balloon will be inflated with helium gas instead of hydrogen, which has been used in practically all other flights. Some of the proposed details of a similar previous flight were outlined by Capt. Albert W. Stevens in an excellent illustrated lecture given before the Society at its Eighty-First Annual Meeting, on January 18, 1934. The 1935 attempt will be under his direction.

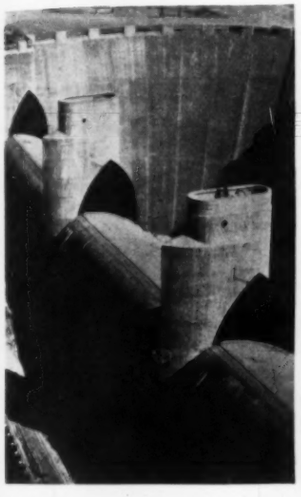
Construction Progresses at and Near Boulder Dam

Recent Views by U. S. Bureau of Reclamation Constitute Graphic Record

LOOKING DOWNSTREAM ALONG TOP OF NEVADA CANYON WALL
Approach Highway Under Construction on April 1, 1935

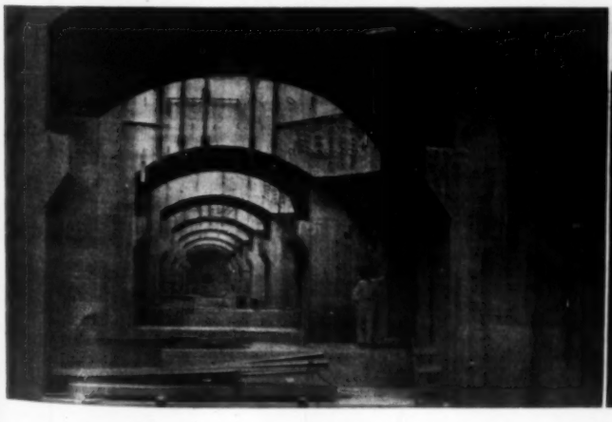
POWER HOUSES PRESENT SCENE OF ACTIVITY FROM TOP OF DAM
Status Late in December 1934. Downstream Cofferdam Just Beyond



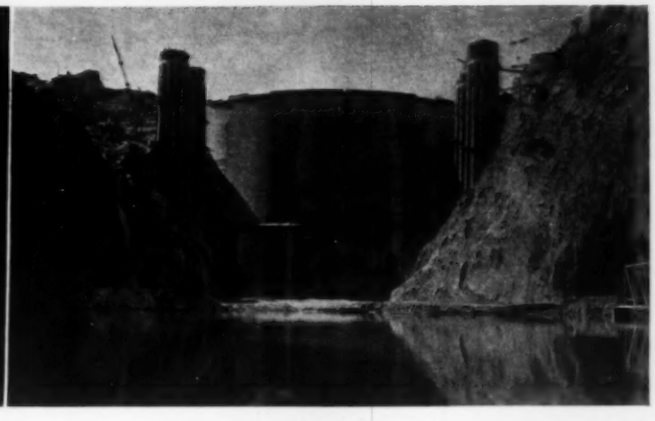


CLOSE-UP OF ARIZONA SPILLWAY
Looking Obliquely Upstream with Weir Gates Lowered. Man in Top of Nearer Tower Shows the Scale

STARTING FOR THE BOTTOM
Government Cableway Picks Up Pipe Section 30 Ft in Diameter from Special Trailer Truck. Mixing Plant in Background



LOOKING THROUGH THE TURBINE GALLERY
A Corridor Running Lengthwise of the Power House



DAM AS SEEN FROM RESERVOIR, IMMEDIATELY UPSTREAM
On March 1, When Reservoir Surface Was About at Elevation 709

Extracurricular Activities and Business Success

By W. L. TURNER, JR.

VIRGINIA POLYTECHNIC INSTITUTE STUDENT CHAPTER

A survey of college men in its employ made by the American Telephone and Telegraph Company, together with studies made by a large university of the college interests of its successful graduates, indicates an apparent connection between extracurricular activities and business success. This article is abstracted from Mr. Turner's address given at the Virginia Student Chapter convention on April 6, 1935. A product of recently renewed interest among the Chapters, it typifies a constructive form of student paper.

RECENTLY THE business and professional world has begun to realize the value of outside activities for college students as a factor in the training of its future employees. In 1925, the American Telephone and Telegraph Company made a survey of the graduates in its service. The collegiate activities of 2,100 men, of whom approximately 75 per cent were engineers, were studied, and the men were classified into three groups. Group A, consisting of 21 per cent of the total, was composed of the men who had made substantial contributions to campus activities. Group B, representing 38 per cent, was made up of the men who had some achievement to their credit, and Group C, approximately 41 per cent, consisted of those who had taken no part whatever in extracurricular activities.

The salaries of each group were averaged over a period of years, and the averages were compared with the median salary of the whole. Group A showed a steady climb from the beginning, and at the end of 25 years was earning 21 per cent more than the average salary of the entire group. Group B showed a decline for the first five years, no change for the next five, and a steady gain for the last fifteen years. At the end of the period, members of Group B were earning 10 per cent more than the general average. Those in Group C were found to have suffered salary cuts during the entire period and at the end of it were earning only 90 per cent of the average salary.

After discovering that extracurricular activities were in part responsible for the success of their employees, the telephone company sought to discover a relation between the field of activity of each student and his success in business. Five fields of endeavor were chosen, and the men in Groups A and B were compared on the basis of their achievements in these fields. The types of activity chosen were respectively editorial and forensic, musical and dramatic, social, managerial, and athletic. It was found that the Group A men in the editorial and forensic field and in the managerial field had had the greatest success, 80 per cent of their number earning salaries above the average for the group. Success of men in the social, athletic, and musical and dramatic fields followed in the order given.

In comparing Groups A and B in these various fields of endeavor, it was found that among those who had substantial achievements to their credit at college there were about 10 per cent more men earning salaries above the average in Group A than in Group B, with the exception of those in the field of athletics. Here it was found that although athletic activity is a decided asset, it apparently makes little difference whether a man is a member of a major team or merely on the squad. The musical and dramatic field was found to be the least favorable, but even here at least 50 per cent of the men were earning salaries above the average.

An investigation recently made by a large mid-western university has brought out facts very similar to the findings of the telephone company. This college compiled a list of all its alumni listed in *Who's Who in America*, certainly its most successful graduates. Their campus activities were classified under the heads of journalism, student government, athletics, and musical and dramatic. The greatest number of the men were found to have been active in journalism, comparing with the editorial and forensic group of the telephone company's investigation. The student government executives were next, comparing with the managerial group of the previously mentioned inquiry. Athletics and musical and dramatic activities followed. Social activities were not studied, as nearly 100 per cent of the alumni listed had been members of fraternities or similar organizations.

These two investigations—one conducted among graduates of colleges and universities throughout the country and the other among the very successful graduates of a single school—show that extracurricular activities appear to be an aid to business success, and that the type of activity excelled in at college is to some extent an indication of the business success a student may expect.

Members of the editorial and forensic group probably owe much of their success to the fact that they have been trained to reason and to express themselves clearly and without embarrassment. In business it frequently becomes necessary to explain something either orally or in writing to a group or to an individual. The man who can do this well places himself in a position where he is likely to receive first consideration when promotions are made.

Those who are managers or officials in student government sometimes develop an executive ability which will stand them in good stead in later years. This is especially true of the managers of publications who must keep within their budgets and direct the men under them. In social fraternities many learn how to make contacts and to get along with others, both valuable accomplishments. On the athletic field one learns team work—how to work with others.

Another type of recreation which has not been discussed is the reading of good books and contemporary articles. The great majority of students read only that worth-while literature which is required in their English courses. This is regrettable, as people often judge a person largely upon his ability as a conversationalist. Without a previous knowledge of literature and current topics, a graduate may often be hopelessly at sea. Realizing that engineers have little time to select the best of modern literature, the personnel director of the Southern Bell Telephone Company from time to time prepares lists of the better new books. He makes comments on them and circulates the list among the employees. The men are not required to read the books, but it has been found that the majority of those promoted have read all or part of them.

Thus the student who takes part in extracurricular activities has a better chance for success in life than one who does not, and if his tastes run to the journalistic field, his chances appear better than they will be if he chooses the glee club. But whatever the field, he should do something to train his faculties and develop such executive ability as he may have. He should mix with others, learn how, as well as what, to think, and remember that no more may be derived from any activity than is put into it.

S.P.E.E. Civil Engineering Conference at Atlanta

IN CONNECTION with the annual convention of the Society for the Promotion of Engineering Education in Atlanta, Georgia, on June 24 and 25, 1935, an attractive conference has been planned for the civil engineering division of that society on the general subject of "Changing Phases of Civil Engineering and Their Relations to Education." In addition to general discussion of civil engineering training, two sessions have been planned with special emphasis on graduate research, seminars, and theses in particular features of civil engineering, including structural, hydraulic-sanitary, and transportation-surveying sections.

In the structural section, these sessions will be devoted to a discussion of the development of courses of instruction in the basic principles and physical constants in soil mechanics, percolation and hydrostatic pressures, foundation pressures, and the use of models in teaching and demonstration. The hydraulic-sanitary section will consider such problems as teaching elementary hydraulic laboratory work as related to the transportation of sediment and the use of models in studying river hydraulics. The transportation-surveying division will be occupied by consideration of the general problem of traffic engineering education.

Leaders in the various subjects are scheduled for addresses. The following members of the Society are on the program: C. C. Williams, H. S. Rogers, W. S. Housel, F. T. Mavis, F. H. McDonald, Anson Marston, L. W. McIntyre, W. T.

Chevalier, F. W. Stubbs, Jr., R. W. Crum, L. G. Straub, W. M. Lansford, K. C. Reynolds, L. F. Rader, H. P. Hammond, D. P. Krynine, and D. M. Burmister.

Members of the Georgia Section of the Society have received special invitations to join the meeting. The dinner meeting on June 24 is expected to be a joint gathering between the civil engineering division of the S.P.E.E. and the Georgia Section of the Society.

All sessions are to be held at the Georgia School of Technology. The attractive plans for this meeting have been developed by the Civil Engineering Council of the S.P.E.E., consisting of Frank Kerekes, Chairman, T. R. Agg, Gordon M. Fair, L. E. Grinter, K. C. Reynolds, and Fred L. Plummer. All are members of the Society. Professor Plummer is in charge of arrangements for these sessions.

Booklet Issued on Colorado River Aqueduct

A LIMITED number of copies of a handsomely illustrated 58-page booklet on the design and construction of the Colorado River Aqueduct is available at the request of Society members through the courtesy of the Metropolitan Water District of Southern California. Requests should be addressed to F. E. Weymouth, M. Am. Soc. C.E., general manager and chief engineer, 306 West Third Street, Los Angeles, Calif. The material was prepared by Julian Hinds, M. Am. Soc. C.E., assistant chief engineer. Articles descriptive of various features of this $284,000,000 project by Messrs. Weymouth and Hinds appeared in the February 1935 issue of CIVIL ENGINEERING. Space limitations there prevented the extended treatment appropriate to the magnitude of the work, but in the pamphlet the main considerations are presented in sufficient detail to make its reading very much worth while.

NEWS OF ENGINEERS

From Correspondence and Society Files

K. L. DE BLOIS has resigned as assistant bridge construction engineer on the San Francisco–Oakland Bay Bridge to accept an appointment as associate highway bridge engineer with the U. S. Bureau of Public Roads in San Francisco, Calif.

PETER J. STUPKA is now with the American Automobile Association in Washington, D.C.

W. H. PENFIELD has been appointed chief engineer of the Chicago, Milwaukee, St. Paul, and Pacific Railroad Company, succeeding the late C. F. LOWETH who resigned May 1 after many years of service.

ROBERT BEATTY, formerly an estimator for the King Construction Company, of Philadelphia, Pa., is now employed as construction engineer by the Berwick Lumber and Supply Company, of Berwick, Pa.

GEORGE J. VIERTEL is now employed by M. Shapiro and Son, engineers and contractors, of New York, N.Y., in the capacity of assistant superintendent of construction. He was formerly with the Westchester Lighting Company, of Mount Vernon, N.Y.

SAMUEL B. MORRIS, chief engineer and general manager of the Pasadena (Calif.) Water Department, has been appointed professor of civil engineering at Stanford University.

WILLIAM BERTWELL has severed his connection with the Montana State Highway Commission to enter the employ of the U. S. Forest Service in the capacity of associate civil engineer.

ENRIQUE GÓNGORA PAREJA has been appointed chief engineer of surveys and designs, Sección de Irrigación, Dirección de Aquas, Ministerio de Fomento, of the Peruvian Government, with headquarters in Lima. He was formerly with the Cerro de Pasco Copper Corporation.

ANANT H. PANDYA is now designing engineer for Messrs. McKenzies, Ltd., of Bombay, India.

WILLARD A. KNAPP has been promoted from the position of professor of engineering extension at Purdue University, LaFayette, Ind., to be assistant dean of the School of Engineering of the same university. He will continue as secretary of the Engineering Experiment Station.

H. B. PULLAR has entered the employ of the Berry Asphalt Company, of Chicago, Ill., in the capacity of vice-president and general manager. He was formerly with the American Mexican Petroleum Corporation.

A. P. ROLLINS, consulting engineer of Dallas, Tex., has been appointed director of public works.

M. H. DAVISON, who was formerly affiliated with the Central Coke and Coal Company of Kansas City, Mo., is now an assistant engineer in the Division of Water Resources of the Kansas State Board of Agriculture. His office is in Topeka, Kans.

NATHAN EPSTEIN has resigned as assistant engineer of the Board of Transportation, Long Island City, N.Y., to accept a position in a similar capacity in the Finance Department of New York City.

JAMES H. BLODGETT is now chief field engineer in the Division of Engineering and Construction of the City of Columbus, Ohio.

CLIFFORD F. PHILLIPS has been made president of the Muskegon Construction Company, of Muskegon, Mich. Previously he was chief engineer and secretary of the Owen, Ames, Kimball Company, of Grand Rapids, Mich.

W. E. BRACKETT, formerly resident engineer for the Maine State Highway Commission, has recently been appointed town manager of Oakland, Me.

ARTHUR RICHARDS is now village engineer for Larchmont, N.Y.

STANFORD P. MCCASLAND has accepted a position with the U. S. Bureau of Reclamation in Denver, Colo.

EUGENE H. SCHNEIDER has severed his engineering connection with the Denver Municipal Water Commission to become designing engineer of the Board of Water Commissioners on the Moffat Water Tunnel Project.

CHARLES K. LEWIS, formerly a junior engineer with the Metropolitan Water District of Southern California, is now a junior engineer cost accountant for the U. S. Forest Service. His headquarters are in South Pasadena, Calif.

MAURICE E. GILMORE is now a state engineer inspector with the PWA, with headquarters in New York, N.Y.

MILTON C. STEUBER has taken a position as project engineer in the Procurement Division of the Treasury Department, with offices in the Federal Warehouse in Washington, D.C.

ALFRED KLAHRE, JR., recently received an appointment with the Tennessee Valley Authority in Knoxville, Tenn. He was formerly a computer with the U. S. Coast and Geodetic Survey.

FREDERICK W. MOUSEL is temporarily in the employ of the Bluefield Telephone Company, of Bluefield, W.Va., in the capacity of engineering records draftsman.

ZINA E. SEVISON is now city engineer of Cheyenne, Wyo.

FRANK M. KELLER has severed his connection with the U. S. Bureau of Public Roads to become acting state engineer inspector of Colorado, with headquarters in Denver, Colo.

J. LESTER BROWN has accepted an engineering position with the International Boundary Commission, with offices in Las Cruces, N. Mex. He was formerly office engineer for the Middle Rio Grande Conservancy district.

RALPH G. REYES has taken a temporary position as computer with the U. S. Coast and Geodetic Survey, with headquarters in New York, N.Y.

E. AGUERREVERE, with his two brothers, has established a consulting engineering office in Caracas, Venezuela. The firm will specialize in geology, geophysics, and civil engineering.

FRANK J. KISH is now employed as principal engineering aide in the construction plant section of the Tennessee Valley Authority, with headquarters in Knoxville, Tenn.

P. C. SHAFER, formerly superintendent of the Maysville Water Company, Inc., of Maysville, Ky., has accepted an appointment as resident engineer of the Ohio State Highway Department, with headquarters in Ravenna, Ohio.

THOMAS W. OWEN, formerly city engineer of Port Angeles, Wash., has taken a position as project engineer for the Washington Emergency Relief Administration, with offices in Olympia, Wash.

C. T. JACKSON has been promoted from the position of special engineer for the Chicago, Milwaukee, St. Paul and Pacific Railroad Company to that of assistant to the chief engineer of the same organization.

EARL M. BUCKINGHAM, formerly with the U. S. Coast and Geodetic Survey, has accepted an appointment as associate engineer in the U. S. Forest Service, with headquarters in San Francisco, Calif.

Changes in Membership Grades

Additions, Transfers, Reinstatements, Deaths, and Resignations

From April 10 to May 9, 1935, Inclusive

ADDITIONS TO MEMBERSHIP

ADDICOTT, LEWIS JAMES (M. '35), Head Dept. of Civ. Eng., and Superv. Archt., Ohio Univ. (Res., 55 Elmwood Pl.), Athens, Ohio.

BEAVERS, VIRGIL LOUIS (Assoc. M. '34), Res. Engr., State Highway Dept.; 402 West 30th St., Austin, Tex.

CLARK, CHARLES OTIS (Jun. '35), With TVA., Chattanooga, Tenn.

CONWAY, HENRY THOMAS (Jun. '35), Gen. Supervisor, FERA (Res., 219 Church St.), Lowell, Mass.

CULP, MELVIN MARK (Jun. '35), Supt., ECW Camp 69-D P E, Box 118, Mounds, Ill.

DEFRANCESCO, DOMINICK (Jun. '34), Rodman and Acting Transitman, Parks Dept. (Res., 532 East 184th St.), New York, N.Y.

DOLL, BYRON EMERSON (Jun. '34), 724 State St., El Centro, Calif.

DREW, SAMUEL TILTON (Assoc. M. '35), Project Engr., Metcalf & Eddy, 1300 Statler Bldg., Boston (Res., 16 Washington St., Braintree), Mass.

ECKHARDT, GEORGE ROBERT (Jun. '34), 278 Fifth St., Newark, N.J.

FISHER, HERMAN ELDRIDGE (Jun. '34), Supervisor, Constr. Training, TVA, Box 333, Joe Wheeler Dam, Ala.

FLORA, WALTER WILSON (Jun. '34), Draftsman, State Bridge Dept., 914 East 18th St., Cheyenne, Wyo.

FLORENCE, ALEXANDER FREDERICK (Jun. '34), 12 Lexington Ave., Maplewood, N.J.

GEORGAKOPULUS, JAMES (Jun. '34), 511 East 148th St., New York, N.Y.

GEUSS, ARTHUR PAUL (Jun. '35), Asst. on Eng. Corps. P.R.R., M. of W. Dept.; 6075 Drexel Rd., Philadelphia, Pa.

GREEN, GROVER (Jun. '34), Box 626, Post, Tex.

HAGUE, JOHN MAXFIELD (Jun. '34), 259 Walnut St., Bloomfield, N.J.

HARMAN, ASHER WATERMAN (Assoc. M. '35), State Engr. and Director of Work Div., Virginia Emergency Relief Administration (Res., 5212 King William Rd.), Richmond, Va.

HEAVEY, WILLIAM FRANCIS (M. '35), Maj., Corps of Engrs., U.S.A.; Asst. to Div. Engr., Great Lakes Div., U. S. Engrs., 419 Federal Bldg., Cleveland, Ohio.

HERMIDA, THOMAS JOSEPH (Jun. '34), With U. S. Coast and Geodetic Survey (Res., 3534 Tenth St., N.W.), Washington, D.C.

HOLMES, CHARLES TROY (Assoc. M. '34), Res. Engr., State Highway Dept., Fort Worth, Tex.

JAQUET, HAROLD HENRY (Assoc. M. '35), Gen. Supt., Jefferson Lake Oil Co., Inc., Erath, La.

JOHNSON, THEODORE RANGNOR (Jun. '34), 1262 Sterling Pl., Brooklyn, N.Y.

KADIE, CARL HENRY, JR. (Jun. '35), Junior Engr., U. S. Dept. of the Interior, Bureau of Reclamation, Box 423, Winterhaven, Calif.

KENNEDY, ROBERT EMORY (Jun. '34), Kappa Alpha Lodge, Union Coll., Schenectady, N.Y.

KURTTILA, GEORGE HENRY (Jun. '35), 717 Michigan Ave., Gladstone, Mich.

LANCEFIELD, ROBERT LYNN (Jun. '35), 2d Lieut., Corps of Engrs., U.S.A., Military Asst. to Dist. Engr., U. S. Engr. Office, Wilmington, N.C.

MALEVICH, STEVEN (Jun. '35), Draftsman, State Dept. of Highways (Res., 344 Becks Run Rd.), Pittsburgh, Pa.

MASLAN, LEON (Jun. '34), With TVA; 303 Crewdson Ave., Chattanooga, Tenn.

MEYERS, LOREL WILLIAM (Jun. '34), 1215 West Brookes, San Diego, Calif.

MOFFETT, ROBERT NELSON (Jun. '35), Draftsman, Philadelphia and Reading Coal & Iron Co. (Res., 1814 Mahantongo St.), Pottsville, Pa.

NOYES, JOHN RUTHERFORD (Assoc. M. '35), Lieut., Corps of Engrs., U.S.A.; Instr. of Engrs., New Mexico National Guard, Box 389, Las Cruces, N.Mex.

PALOCSAY, FRANK STEVE (Assoc. M. '35), Insp., U. S. Engrs., U. S. Engrs. Office, Federal Bldg., Nebraska City, Nebr.

PEEBLES, ARCHIBALD (Jun. '35), Instr., Dept. of Civ. Eng., Univ. of British Columbia (Res., 2911 West 15th Ave.), Vancouver, B.C., Canada.

PENNA, NICHOLAS (Assoc. M. '35), Chf. of Party, County Engrs. of Westchester, White Plains (Res., 114 Fremont St., Harrison), N.Y.

QUAYLE, LLOYD ROBERT (Assoc. M. '34), Asst. Trustee and Controller, Fruit Industries, Ltd., 270 Broadway, Room 1001, New York, N.Y. (Res., 8 Adams Pl., Glen Ridge, N.J.)

REID, JAMES HOWARD (Jun. '34), 523 Pittock Blk., Portland, Ore.

REYNOLDS, CHARLES ALBERT, JR. (Jun. '34), 1033 Fulton Ave., San Antonio, Tex.

ROBINSON, BENJAMIN PERRY (Jun. '35), 1847 University Ave., New York, N.Y.

SAYRE, RALPH HAROLD, JR. (Jun. '34), 228 Laurel Ave., Maplewood, N.J.

SMITH, BURTON LYNCH (Jun. '35), Project Engr., U. S. Indian Service, Box 905, Sante Fe, N.Mex.

SNIDER, ARTHUR MILTON (Assoc. M. '34), Engr., Jensen, Bowen & Farrell, Ann Arbor (Res., 1913 West Six Mile Rd., Detroit), Mich.

STEWART, DOUGLAS MACMILLAN (Jun. '35), 910 Ostrum St., Bethlehem, Pa.

TOWNSEND, HENRY MCDONALD (Jun. '35), Junior Topographical Engr., U. S. Geological Survey, Washington, D.C.

WANG, YANK TSENG (Assoc. M. '35), Chf. Engr., Saratsi Irrig. Works, Saratsi, Suiyuan, China.

WANKMULLER, JACOB WILLIAM THOMAS (Jun. '35), 26 Sheridan Ave., Brooklyn, N.Y.

WEBSTER, FRANK WATKINS (M. '35), Prin. Highway Engrs., TVA (Res., 2027 Terrace Ave.), Knoxville, Tenn.

WILLIAMS, BYRD MOORE, JR. (Assoc. M. '35), Const. Engr., City of Fort Worth (Res., 3137 Wabash Ave.), Forth Worth, Tex.

WINICK, CHARLES BORIS (Assoc. M. '35), Res. Engr.-Insp., PWA, New York (Res., 183 East 51st St., Brooklyn), N.Y.

WOLFF, HERBERT ALBERT (Jun. '34), 1937 Wilmette Ave., Wilmette, Ill.

TOTAL MEMBERSHIP AS OF MAY 9, 1935	
Members	5,688
Associate Members	6,114
Corporate Members	11,802
Honorary Members	18
Juniors	3,077
Affiliates	99
Fellows	2
Total	14,998

MEMBERSHIP TRANSFERS

ANDERSON, GEORGE RANDOLPH (Jun. '26; Assoc. M. '35), Junior Designer, State Highway Comm., General Delivery, Washington, Kans.

BABEL, HERMAN (Assoc. M. '24; M. '35), Asst. Engr., Erecting Dept., Am. Bridge Co., 1526 Frick Bldg., Pittsburgh, Pa.

COMBS, THEODORE CARLOS (Jun. '30; Assoc. M. '35), Field Engr., National Lumber Mfrs. Assoc. and Timber Eng. Co., 717 F. P. Fay Bldg., Los Angeles (Res., 3321 East Ocean Boulevard, Long Beach), Calif.

CRANDELL, OLIN HICKS (Jun. '24; Assoc. M. '35), Engr., Magnolia Petroleum Co. (Res., 818 Eli Ave.), Dallas, Tex.

CURRAN, CHARLES DANIEL (Jun. '32; Assoc. M. '35), Lieut., Corps of Engrs., U.S.A.; Care Wray, 60 Clarkson Ave., Apartment 6 M, Brooklyn, N.Y.

EASLEY, ROBERT PURL (Assoc. M. '30; M. '35), Civ. Engr. and Contr., 508 Fifth St., Antioch, Calif.

EVERS, WILLIAM HENRY, JR. (Jun. '25; Assoc. M. '34), Cons. Engr., 1532 Standard Bank Bldg., Cleveland, Ohio.

FOCHT, JOHN ARNOLD (Assoc. M. '28; M. '35), Prof., Highway Eng., Univ. of Texas (Res., 2823 Salado St.), Austin, Tex.

GELSTON, ARTHUR SANFORD (Assoc. M. '32; M. '35), Res. Engr., Joint State Highway Dist. 13; 2424 Dowling Pl., Berkeley, Calif.

GREEN, CARL EDWIN (Jun. '28; Assoc. M. '35), State San. Engr., State Board of Health, 816 Oregon Bldg., Portland, Ore.

HOGAN, JOSEPH VINCENT (Assoc. M. '12; M. '35), Pres., The Arundel Corporation, Pier 2, Pratt St., Baltimore, Md.

JOHNSON, FRANK MELVIN S. (Jun. '11; Assoc. M. '18; M. '35), Maj., Corps of Engrs., U.S.A.; Prof. Military Eng. and Head, Military Dept., Colorado School of Mines, Box 443, Golden, Colo.

MOORMAN, ROBERT BURRUS BUCKNER (Jun. '29; Assoc. M. '35), Asst. Prof., Civ. Eng., Univ. of Mississippi, University (Res., 713 South 8th St., Oxford), Miss.

PROCTOR, RALPH ROSCOE (Assoc. M. '27; M. '35), Field Engr., Bureau of Water Works and Supply, City of Los Angeles, 207 South Broadway, Room 854, Los Angeles (Res., 1338 Moncado Drive, Glendale), Calif.

ROETMAN, EDMOND TEERINK (Jun. '27; Assoc. M. '35), Engr., Tygart Valley Homesteads, Div. of Subsistence Homesteads, Dept. of the Interior (Res., 414 South Randolph Ave.), Elkins, W.Va.

SHUPTRINE, HARRY AUGUSTUS (Assoc. M. '21; M. '35), Bridge Engr., Board of Wayne County Road Commrs., 3800 Barlum Tower Bldg. (Res., 16528 Westmoreland Rd.), Detroit, Mich.

VANDERLIP, ARTHUR NELSON (Jun. '31; Assoc. M. '34), 225 Ridgedale Rd., Ithaca, N.Y.

WALLACE, JOHN HERBERT, JR. (Jun. '26; Assoc. M. '35), With Petroleum Equipment Co., 2800 South Alameda St. (Res., 1002 Sanborn Ave.), Los Angeles, Calif.

WEEBER, EARL RICHARD (Assoc. M. '25; M. '35), Cons. Engr. (Hamilton & Weeber) (Res., 2130 Paris Ave., S.E.), Grand Rapids, Mich.

WILSON, MURRAY ALDERSON (Assoc. M. '28; M. '35), Owner, The Wilson Eng. Co., 315 Farmers Union Bldg., Salina, Kans.

REINSTATEMENTS

BELDEN, GEORGE ALLYNE, Assoc. M., reinstated May 7, 1935.

LEIGHTON, MARSHALL ORA, M., reinstated April 10, 1935.

TIFFANY, ROSS KERR, JR., Jun., reinstated May 8, 1935.

VAN VLECK, ALBION NOYES, M., reinstated April 15, 1935.

VON SCHOELER, VICTOR JOSEPH, Assoc. M., reinstated April 22, 1935.

RESIGNATIONS

CHIBA, TOSHITOMO, Assoc. M., resigned April 10, 1935.

HIPP, CHARLES LEO, Jun., resigned May 7, 1935.

MARTIN, WILLIAM NOBLE, Jun., resigned May 7, 1935.

MITCHELL, SIDNEY JAY, Jun., resigned April 15, 1935.

SCHMITT, WALTER FREDERICK, Jun., resigned May 7, 1935.

SPROL, SAMUEL JOSEPH, Assoc. M., resigned April 9, 1935.

TOOLEY, WILLIAM PAUL, Jun., resigned April 22, 1935.

WEIL, CONRAD, JR., Jun., resigned May 2, 1935.

DEATHS

ARMITAGE, GEORGE WASHINGTON. Elected Assoc. M., April 2, 1902; died April 24, 1935.

ATWATER, ALMON BYRON. Elected M., May 5, 1886; died March 6, 1935.

BASSETT, HERBERT HOWARD. Elected M., Nov. 28, 1916; died April 26, 1935.

CHILDS, JAMES ALANSON. Elected Assoc. M., April 18, 1916; M., Jan. 16, 1928; died April 13, 1935.

CLARKE, ERNEST WILDER. Elected M., Jan. 4, 1905; died April 24, 1935.

HANNA, JOHN VENABLE. Elected Assoc. M., May 3, 1893; M., April 2, 1902; died April 30, 1935.

HARNEY, FRANCIS VINCENT. Elected Assoc. M., Dec. 15, 1924; died April 11, 1935.

HURTGEN, HAROLD RAY. Elected Jun., Oct. 24, 1932; died April 12, 1935.

MORRIS, ROBERT FARLEY. Elected Assoc. M., April 7, 1930; died Feb. 17, 1935.

MURPHY, JAMES CORNELIUS. Elected M., June 6, 1911; died April 14, 1935.

MURPHY, JOSEPH AMBROSE. Elected Assoc. M., Dec. 14, 1925; died March 9, 1935.

NUTTING, HORACE WINTER. Elected Assoc. M., Feb. 24, 1931; died April 8, 1935.

PERRY, CHARLES NAPIER. Elected M., Aug. 9, 1920; died April 20, 1935.

REED, WILLIAM THOMAS. Elected Assoc. M., Feb. 28, 1911; died April 28, 1935.

ROBERTS, HARRY ASHTON. Elected Jun., April 5, 1904; Assoc. M., Dec. 5, 1906; date of death unknown.

SMITH, WILLIAM AUGUSTUS. Elected Assoc. M., April 16, 1918; M., March 30, 1931; died April 16, 1935.

WITT, JACKSON FRANKLIN. Elected Assoc. M., Oct. 31, 1911; M., Sept. 21, 1915; date of death unknown.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment of Members to Board of Direction

June 1, 1935 NUMBER 6

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years*	5 years of important work
Associate Member	Qualified to direct work	27 years	8 years*	1 year
Junior	Qualified for sub-professional work	20 years†	4 years*	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years*	5 years of important work
Fellow	Contributor to the permanent funds of the Society			

* Graduation from an engineering school of recognized reputation is equivalent to 4 years of active practice.

† Membership ceases at age of 33 unless transferred to higher grade.

The fact that applicants refer to certain members does not necessarily mean that such members endorse.

FOR ADMISSION

BATES, WILLIAM LEWIS, Guilford, Maine. (Age 24.) Refers to H. S. Boardman, E. H. Sprague.

BOHL, LEIGHTON TEETERICK, Edgewood, R.I. (Age 45.) Prof. of Civ. Eng., Brown Univ.; also State Representative, Coast and Geodetic Survey, and Cons. Engr. Refers to J. H. Caton, 3d, T. H. Coe, H. W. Congdon, H. Cross, I. W. Patterson, S. Wilmot, F. E. Winsor.

BOYD, ALFRED DEWITTE, San Antonio, Tex. (Age 35.) Civ. Engr. (Associate), U. S. War Dept. Refers to F. W. Cawthon, O. D. Filley, F. M. Keller, P. P. Livingston, D. H. McCoskey, L. G. Straub, H. C. Whitehurst.

BRAUN, HENRY, New York City. (Age. 26.) Refers to J. Meltzer, D. C. Serber, G. M. Serber.

CROCKER, FRED WILBUR, Portland, Ore. (Age 49.) Refers to A. H. Abel, F. M. Cortelyou, F. T. Crowe, S. Hardesty, E. E. Howard, C. E. Paine, C. F. Swigert, H. P. Treadway.

DOWNS, EDWARD RICHARDSON, Kansas City, Mo. (Age 22.) Refers to E. B. Black, W. C. McNown, N. T. Veatch, Jr.

FOLEY, EDWARD WILLIAM, Brooklyn, N.Y. (Age 58.) Pres., Faircroft Eng. Corporation. Refers to H. C. Booz, W. J. Douglas, G. T. Hand, J. P. Hogan, R. H. Jacobs, W. D. Malcolm, W. S. Menden, E. P. Palmer, E. W. Stearns, L. S. Stiles.

HANSEN, JOHN RUDOLPH, JR., Superior, Mont. (Age 23.) Refers to I. L. Collier, G. E. Hawthorn, C. C. More, F. H. Rhodes, Jr., R. G. Tyler.

HARRIS, ALBERT BULLEN, Tucson, Ariz. (Age 26.) Jun. Hydr. Engr., Water Resources Branch, U. S. Geological Survey, Dept. of Interior. Refers to G. D. Clyde, O. W. Israelsen, H. R. Kepner, F. Schaub, R. B. West.

HARTLEY, ROBERT WILLARD, Columbus, Ohio. (Age 24.) Refers to G. E. Large, C. T. Morris, R. H. Randall, J. R. Shank.

HAVAS, GEORGE, Bonneville, Ore. (Age 31.) Chf. Engr., Columbia Constr. Co., Bonneville (Ore.) Spillway Dam. Refers to A. H. Ayers, C. F. Calhoun, F. T. Crowe, A. Donaldson, G. E. Goodwin, A. R. Olds, J. L. Savage, W. R. Young.

HEFELPINGER, CHARLES MOSES, Allentown, Pa. (Age 26.) With Linus R. Gilbert, Inc., Contrs., Plainfield, N.J. Refers to F. J. Biele, W. H. Boardman, H. M. Herbert, C. J. Laube, H. G. Payrow.

HUDSON, WILLIAM NORTON, Bay Village, Ohio. (Age 43.) Chf. Engr., The Wertz Co., Cleveland, Ohio. Refers to A. A. Burger, J. A. Giles, G. W. Hamlin, W. Mueser, C. H. Splitstone, R. A. Van Ness.

KIENIA, MAKAR ALEXANDROVICH, Moskow, U. S. S. R. (Age 35.) Chf. Constr. Engr. on bridge construction with U. S. S. R. Refers to J. G. Alexandroff, N. Cosores, S. Hardesty, L. S. Moisseiff, L. J. Proctor, J. A. L. Waddell.

LAWSON, DAVID, New York City. (Age 49.) Senior Engr., TERA. Refers to W. Allan, A. W. Buel, R. S. DuBois, S. Johannesson, L. R. Newhall.

LEE, JOHN NELSON, Honolulu, Hawaii. (Age 38.) Asst. Engr., Board of Water Supply. Refers to H. A. R. Austin, J. F. Kunesh, G. K. Larrison, F. Ohrt, W. H. Samson, C. D. Tarleton, E. C. Wilder.

LENEHAN, GEORGE WARDEN, Vicksburg, Miss. (Age 27.) Inspector and Jun. Engr., U. S. Waterways Experiment Station. Refers to I. G. Hedrick, K. V. Jones, H. A. Sargent, W. R. Spencer, R. B. Tinsley, C. P. Wright.

MCCUNE, FREDERICK LEO, Seattle, Wash. (Age 24.) Refers to I. L. Collier, C. W. Harris, G. E. Hawthorn, C. C. More, F. H. Rhodes, Jr., R. G. Tyler.

MATSON, ROSSER HOLLOWAY, Iowa City, Iowa. (Age 31.) Water Resources Coordinator, Iowa State Planning Board. Refers to J. J. Hinman, Jr., R. G. Kasel, B. J. Lambert, F. T. Mavis, A. H. Wieters, C. C. Williams, D. L. Yarnell.

MENDENHALL, JOHN DALE, Van Nuys, Cal. (Age 23.) Concrete Inspector, Metropolitan Water Dist. of Southern California. Refers to F. J. Converse, R. R. Martel, D. C. May, W. W. Michael, J. Stearns, F. Thomas, W. E. Whittier.

MERCHANT, GEORGE BRITE, Louisville, Ky. (Age 46.) Chf. Engr. and Gen. Supt., Andrews-Collings Asphalt Co. Refers to C. A. Bingham, D. B. Davis, H. H. Kranz, A. A. Krieger, G. F. S. Schlesinger, H. W. Skidmore.

MICHENER, PERCY ZELL, Springfield, Ill. (Age 31.) Asst. Highway Engr., Bureau of Bridges, Illinois Div. of Highways. Refers to R. R. Benedict, G. F. Burch, E. D. Dryfoose, C. M. Hathaway, C. E. Morgan, T. C. Shedd, W. D. P. Warren.

MITSCH, JOHN DONALD, Roslindale, Mass. (Age 37.) Asst. Prof. in Civ. Eng., Massachusetts Inst. of Technology. Refers to H. L. Bowman, C. B. Breed, W. M. Fife, J. W. Howard, E. Mirabelli, C. M. Spofford, C. H. Sutherland.

NOWACZEK, FRANK HUXLEY, Brooklyn, N.Y. (Age 31.) Asst. Engr., Governor's Comm. on Unemployment Relief. Refers to R. W. Armstrong, H. R. Bouton, H. A. Dibbell, D. G. Follett, H. P. Hammond, F. B. Marsh.

ORD, MELVIN JAMES, Vicksburg, Miss. (Age 23.) Gauge Reader, U. S. Waterways Experiment Station. Refers to B. A. Etcheverry, S. T. Harding.

OUTLAND, GILBERT WAYNE, Pasadena, Cal. (Age 33.) Designer, Los Angeles County Flood Control Dist. Refers to S. B. Barnes, L. D. Gifford, A. Jones, W. J. Manetta, S. B. Morris, C. E. Pearce, V. L. Peugh, C. W. Sopp, R. White.

PEABODY, DEAN, Brookline, Mass. (Age 46.) Associate Prof., Massachusetts Inst. of Technology, Cambridge, Mass. Refers to J. B. Babcock, 3d, C. B. Breed, A. W. Dean, W. H. Norris, C. M. Spofford.

PONDER, HUBERT LAWSON, Tallahassee, Fla. (Age 23.) Engr. and Draftsman, U. S. ECW, under Florida Forest Service. Refers to R. P. Black, J. H. Johnston, F. C. Snow.

SCHLITT, HENRY GEORGE, Lincoln, Nebr. (Age 28.) Asst. Bridge Engr., State Dept. of Roads and Irrigation. Refers to F. T. Darrow, C. M. Duff, W. Grant, J. G. Mason, C. E. Mickey, J. I. Quinn.

SOUCEK, EDWARD, Iowa City, Iowa. (Age 25.) Asst. Engr., Iowa State Planning Board. Refers to J. W. Howe, R. G. Kasel, B. J. Lambert, F. T. Mavis, C. C. Williams, D. L. Yarnell.

TAYLOR, DONALD WOOD, Cambridge, Mass. (Age 34.) Research Asst. in Soil Mechanics, Dept. of Civ. and San. Eng., Massachusetts Inst. of Technology; also Graduate student. Refers to M. B. Arthur, C. B. Breed, E. A. Dow, G. Gilboy, E. F. Miner, H. T. Pierce, C. M. Spofford.

TEALL, LEWIS WHITNEY, Ashland, Kans. (Age 25.) Field Engr., U. S. Forest Service. Refers to L. E. Conrad, A. C. Stiefel.

TUTTLE, RALPH GODFREY, Seattle, Wash. (Age 22.) Refers to I. L. Collier, G. E. Hawthorn, C. C. More, F. H. Rhodes, Jr., R. G. Tyler.

VAUGHAN, EVAN WILLIAM, Knoxville, Tenn. (Age 27.) Eng. Aide, Gen. Eng. Div., TVA. Refers to G. E. Barnes, G. B. Earnest, F. L. Plummer, W. E. Rice, D. Y. Swaty.

WHEELER, WALTER MCCLAVE, Grand Island, Nebr. (Age 35.) City Engr., Grand Island, Nebr. Refers to E. W. Bennison, J. A. Bruce, R. M. Green, H. J. Kesner, F. M. Veatch, W. Ward.

WHITEHEAD, LINDSEY WOOD, State College, Pa. (Age 46.) Associate Prof. of Civ. Eng. and in charge of Div. of Surveying; also Staff Asst. in Civ. Eng., Dept. of Grounds and Buildings, Pennsylvania State Coll. Refers to R. O'Donnell, R. L. Sackett, H. B. Shattuck, C. M. Spofford, E. D. Walker.

WILSON, GUTHLAC, Calcutta, India. (Age 33.) With Braithwaite & Co., Engrs., Ltd. Refers to S. E. Faber, R. Freeman. (Applies in accordance with Sec. 1, Art. I, of the By-Laws.)

FOR TRANSFER

FROM THE GRADE OF ASSOCIATE MEMBER

BLANEY, HARRY FRENCH, Assoc. M., Los Angeles, Cal. (Elected Aug. 28, 1922.) (Age 42.) Irrigation Engr., U. S. Dept. of Agriculture, Dept. of Irrigation. Refers to F. D. Bowlus, H. Conkling, S. T. Harding, S. H. McCrory, F. C. Scobey, A. L. Sonderegger, K. Q. Volk.

CLEMENS, GEORGE REGINALD, Assoc. M., Vicksburg, Miss. (Elected April 23, 1928.) (Age 35.) Senior Engr., Mississippi River Comm. Refers to C. E. Boesch, H. W. King, E. W. Lane, T. B. Larkin, A. Marston, G. H. Matthes, P. S. Reinecke.

ENGLANDER, HARRY, Assoc. M., Williston Park, N.Y. (Elected Aug. 28, 1922.) (Age 48.) With Moran & Proctor and H. J. Deutschbein Co., Inc., on work for Red River Bridge Dist., New York City. Refers to A. Allaire, L. L. Brown, F. S. Crowell, H. J. Deutschbein, G. L. Freeman, E. H. Harder, E. Pittarelli, C. S. Proctor.

KANG, SHIH-CHENG, Assoc. M., Nanking, China. (Elected Junior July 9, 1923; Assoc. M. March 14, 1927.) (Age 39.) Senior Engr. and Acting Vice-Director, Bureau of Roads, National Economic Council of China. Refers to J. E. Elliott, H. S. Jacoby, F. C. Moore, H. A. Vanderbeek, J. E. Wadsworth.

LOSEE, JAMES ROBERT, Assoc. M., Tarrytown, N.Y. (Elected Nov. 21, 1921.) (Age 46.) Civ. Engr. and Surveyor; Engr. and Supt., Tarrytown Water-Works; Village Engr., Tarrytown. Refers to H. P. Barnes, H. A. Helling, C. MacDonald, G. H. Martin, Jr., D. C. Nolan, Jr., C. H. Sells, F. C. Zeigler.

PROCTOR, ASA GLISSON, Assoc. M., Woodland, Cal. (Elected Junior Oct. 4, 1910; Assoc. M. Nov. 3, 1915.) (Age 50.) Engr., Yolo County; City Engr., Woodland; Civ. Engr. and Consultant. Refers to R. A. Beebee, H. D. Dewell, H. M. Jones, C. D. Marx, J. O. Miller, R. J. Reed, C. B. Wing.

RIDGWAY, HERBERT, Assoc. M., New York City. (Elected July 6, 1920.) (Age 44.) Designing Engr., American Bridge Co. Refers to H. G. Balcom, C. F. Goodrich, O. E. Hovey, F. C. Moore, B. B. Priest, J. E. Wadsworth.

SCHAEFER, GEORGE ALLEN, Assoc. M., Middletown, Conn. (Elected Junior Jan. 15, 1923; Assoc. M. March 14, 1926.) (Age 37.) Supt., Dept. of Public Works. Refers to C. M. Blair, H. T. Burgess, C. A. Campbell, C. W. Hudson, G. P. Morrill, L. F. Peck, J. P. Wadhams.

VETTER, CARL PETER PEDERSEN, Assoc. M., Denver, Colo. (Elected July 11, 1927.) (Age 42.) Engr., U. S. Bureau of Reclamation. Refers to J. D. Galloway, H. R. McBirney, C. M. Mardel, J. L. Savage, I. C. Steele.

WINSOR, LUTHER MURKINS, Assoc. M., Minot, N.Dak. (Elected March 15, 1926.) (Age 51.) Engr. in charge of construction of migratory water-fowl refuge program of Biological Survey, U. S. Dept. of Agriculture. Refers to G. D. Clyde, R. A. Hart, O. W. Israelsen, R. B. Ketchum, R. R. Lyman, F. C. Scobey, R. B. West.

FROM THE GRADE OF JUNIOR

BIRMAN, HERMAN, Jun., New York City. (Elected March 15, 1926.) (Age 32.) Supt. of Constr., Works Div., Dept. of Parks. Refers to W. R. Bascome, T. B. Brogan, R. Eberlin, A. Haring, A. E. Hilliard, C. T. Schwarze.

HAWES, LORIN LINDLEY, Jun., Coya, Rancagua, Chile. (Elected Feb. 19, 1934.) (Age 32.) Asst. Hydr. Engr., Braden Copper Co. Refers to C. D. Ashbrook, C. Barahona Munoz, P. L. Spanne, H. D. Stockwell, J. W. Straney.

MOSIER, RAY ROSEVELT, Jun., Cherokee, Iowa. (Elected April 25, 1932.) (Age 29.) Refers to C. H. Apple, L. W. Cox, R. D. Goodrich, H. T. Person, N. Williams.

PENDLETON, JULIAN BREWSTER, Jun., Maracaibo, Venezuela. (Elected July 16, 1928.) (Age 32.) Constr. Foreman, Lago Petroleum Corporation. Refers to J. O. Davis, A. W. French, C. J. Gooch, J. W. Howe, R. Kleppe, R. R. Wiggins.

PEOT, WERNER ANTHONY, Jun., Milwaukee, Wis. (Elected Feb. 24, 1931.) (Age 30.) Draftsman, Class A, Milwaukee Sewerage Comm. Refers to J. L. Ferebee, A. L. Kurtz, W. Landsiedel, H. E. Nicol, D. W. Townsend.

PICKETT, ARTHUR GORDON, Jun., Pasadena, Cal. (Elected Oct. 12, 1925.) (Age 32.) Civ. Engr., Grade III, with Los Angeles County Surveyor. Refers to C. E. Arnold, C. R. Compton, B. F. Dupuy, W. F. Foster, A. Jones, O. de la V. Keese, W. W. Michael, T. I. Phelps, A. M. Rawn, W. K. Runyon, A. S. Zinn.

POU, FRANK EUGENE STANTON, Jun., Mount Hebron, Ala. (Elected June 6, 1927.) (Age 32.) Bridge Inspector, State Highway Dept. of Alabama, Birmingham. Refers to G. J. Davis, Jr., W. Finnell, L. Gottlieb, H. H. Hendon, S. C. Houser, R. D. Jordan.

ROOS, SIGMUND, Jun., Dover, N.J. (Elected Oct. 14, 1929.) (Age 28.) Prin. Eng. Draftsman, U. S. War Dept., Picatinny Arsenal.

Refers to E. H. Anson, C. B. Ferris, A. Haring, E. L. Moreland, J. H. Quimby, C. T. Schwarze.

SCHUERMAN, LESLIE ROBBINS, Jun., Princeton, N.J. (Elected Nov. 12, 1928.) (Age 30.) Asst. Prof. of Civ. Eng., Princeton Univ. Refers to G. E. Beggs, E. R. Cary, H. F. Harris, F. A. Heacock, P. Kissam.

SMITH, CHARLES FRANCIS, Jun., Casper, Wyo. (Elected July 12, 1926.) (Age 32.) Engr., Standard Oil Co. of Indiana. Refers to H. L. Baldwin, J. O. Ball, H. Cross, W. C. Huntington, R. B. Ketchum, W. M. Wilson.

SORENSEN, ALTON HARRY, Jun., Salt Lake City, Utah. (Elected March 14, 1927.) (Age 33.) Engr. with Caldwell & Richards, Civ. Engrs. Refers to H. Cross, W. C. Hungtington, R. B. Ketchum, R. R. Lyman, A. Z. Richards, W. M. Wilson.

SORKIN, JOSEF, Jun., Helena, Mont. (Elected Nov. 11, 1929.) (Age 29.) Bridge Designer, Montana State Highway Comm. Refers to W. Grant, H. J. Kesner, J. G. Mason, C. E. Mickey, J. I. Quinn, J. Singleton, K. E. Vogel.

STURTEVANT, MERRILL HOUSTON, Jun., Syracuse, N.Y. (Elected March 16, 1925.) (Age 33.) Asst. Engr., Syracuse Grade Crossing Comm. Refers to E. F. Berry, C. S. Herrick, G. D. Holmes, L. Mitchell, N. F. Pitts, Jr.

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

Men Available

These items are from information furnished by the Engineering Societies Employment Service, with offices in Chicago, New York, and San Francisco. The service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 87 of the 1935 Year Book of the Society. To expedite publication, notices should be sent direct to the Employment Service, 31 West 39th Street, New York, N.Y. Employers should address replies to the key number, care of the New York Office, unless the word Chicago or San Francisco follows the key number, when it should be sent to the office designated.

CONSTRUCTION

CONSTRUCTION ENGINEER AND CONTRACTOR; M. Am. Soc. C.E.; age 54; desires position with executive responsibility on hydro-electric development, dams, municipal improvements, paving, bridges, heavy excavation, and grading. Over 30 years responsible charge of design and construction of important works; thorough knowledge of economical methods of cost and efficient management. A-4827.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; age 30; married; 9 years experience on municipal sewer and street construction; 4 years on municipal topographical surveys. Available immediately; location immaterial. D-3880.

CONSTRUCTION; Jun. Am. Soc. C.E.; 25; licensed land surveyor; now engineer-inspector of water-works construction; 3 years experience on construction of bridges, grade crossing eliminations, retaining walls, station facilities, sewers, pavements, etc. Land and topographic surveys. Desires permanent connection with consulting engineer, contractor, or corporation. Available July 1. D-2876.

DESIGN

CIVIL ENGINEER; Jun. Am. Soc. C.E.; age 28; B.S. in C.E.; 6 years of broad experience in the design and construction of sewage disposal plants, concrete buildings, water works, gas-distribution systems, highways, and concrete bridges; accurate and neat draftsman; desires connection with industrial or utility corporation or consulting engineer. D-2559.

EXECUTIVE

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; C.E., Cornell University, 1914; 20 years experience in all phases of building construction, office and field; executive positions as sales executive, chief estimator, and contract manager. Qualified for plant engineer, manufacturing or chemical plant, or as executive, where business and technical knowledge of construction are essential. D-3841.

STRUCTURAL ENGINEER; Jun. Am. Soc. C.E.; 31; technical graduate; married; good executive; excellent health; 10 years experience with fabricators, railroads, and consulting engineers in design, estimating, detailing, and construction of bridges, mill and office buildings; excellent references; available now; location immaterial. D-3818.

BRIDGE ENGINEER; M. Am. Soc. C.E.; 42; married; university graduate; 15 years experience in responsible capacity, designing and constructing large bridges, fixed and movable, railway and highway, including foundations. Now completing three-year project. Seeking position as bridge or consulting engineer in charge of design and construction of extensive project. B-9954.

GRADUATE CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 34; 11 years experience—6 years on water supply, hydro-electric, other utility design, topographic surveys, filter plant construction, and 5 years on state supervision of dams, checking designs, approval of sites and foundations. Desires permanent connection with consulting engineer or utility. East preferred. D-3874.

EXECUTIVE; M. Am. Soc. C.E.; highway and municipal engineer; 53; married; B.S. and C.E., Missouri University School of Mines, 1908; 30 years experience; 15 years in last position; desires position; experience covers rural highway engineering as well as municipal and park work. Location secondary; available immediately. A-908.

ORIGINATION, PROMOTION, BUSINESS SURVEY, SALES; M. Am. Soc. C.E.; 30 years experience, including design, construction, management of public utility, railroads, and industrial fields. Available on short notice. Any location. B-3987.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 30; B.S. in C.E.; 8 years experience on railroad, highway, bridge, water works, and sewer construction; 2 years as office manager of personnel department of railroad; available immediately; will travel. C-1327.

ENGINEER; Assoc. M. Am. Soc. C.E.; 46, married, New York State professional engineers license; 9 years experience estimating costs and supervising construction of steam-distribution systems; 6 years as oil field engineer; 4 years on railroad and highway construction. Desires position with steam-heating company. D-3901.

EXECUTIVE, SALES MANAGER, SALES AND STRUCTURAL ENGINEER; Assoc. M. Am. Soc. C.E.; 41; married; graduate; thoroughly experienced in sales and allied engineering, including valuation and appraisal work. Seeking position with valuation and appraisal engineer, architect, building material manufacturer, or general contractor. Good designer and estimator. Available soon. D-16.

JUNIOR

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 21; single. B.C.E., University of Minnesota, 1934; excellent scholastic record; graduate work in sewage disposal and hydraulics. Experience as draftsman and college instructor of engineering drawing and structural drafting. Desires work in engineering—preferably sanitary, structural, or hydraulics—or teaching. Location immaterial —United States or foreign. D-3864.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 25; single; B.S. in C.E.; 4 years heavy construction experience, including supervising, inspecting, surveying, estimating, and drafting. Graduate work in sanitary engineering. Desires connection with industrial or utility corporation, or consulting engineer. Location immaterial—United States or foreign countries. Salary open. Available immediately. Interviews solicited. D-2319.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; married; age 31. Experience: two years highway, one year structural, one year mining, and one year civil engineering. Education: B.S. in civil engineering and graduate study in structural and sanitary engineering. Good references. Location, United States or foreign. C-3977.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; single; 26; B.S. in C.E., University of Minnesota, 1932; employed as surveyman for U. S. Coast and Geodetic Survey, as inspector of construction materials for U. S. Engineers. Desires opportunity in any branch of civil engineering. Available immediately. Salary secondary. Location immaterial. D-3879.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 22; single; B.S. in C.E., New York University, 1934; majored in sanitary engineering; desires position as engineering apprentice or junior engineer in any branch of civil engineering, or as statistician. Location immaterial. Available immediately. D-3870.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; married; B.S. in C.E., Pennsylvania State College; 5 years experience with Pennsylvania Department of Highways; experience as inspector on concrete work; surveying; assistant superintendent of maintenance; desires administrative position. Location eastern United States. D-3885.

CONSTRUCTION ENGINEER; Jun. Am. Soc. C.E.; 26; married; 2½ years experience, since graduation, on Colorado River aqueduct in tunnel construction (as miner), and in all types of surveying, including photographic topography; also experience as layout man and foreman of plant construction. Can handle men. Desires opportunity in any capacity. D-3894.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 26; single; B.S. in C.E., Duke University, 1933. Majored structural design and water supply; 1 month with U. S. Coast and Geodetic Survey; 3 months experience, water and sewage works; 3 years as inspector of telephone apparatus. Desires opportunity in any branch of civil engineering. Location immaterial. Available immediately. D-2683.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 26; single; B.S. and C.E.; New Jersey license; 2 years as assistant engineer on investigation, survey, and design of flood control and water-supply projects; 2 years on private surveys; 2 years as construction foreman; 3 years as instructor in evening college; 3 months in state highway work; desires working or teaching position. Best references. D-2248.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 28; single; graduate of Virginia Military Institute; 8 years experience highway and bridge design and

construction; 6 months railways valuation. Desires position with construction or consulting firm. Available two weeks notice. D-3896.

TEACHING

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; married; B.S. in C.E., Massachusetts Institute of Technology; M.S. in C.E., Yale University; recent graduate study at Massachusetts Institute of Technology; 10½ years practical experience in design and construction of bridges, buildings, and dams; 10 years teaching structural engineering, concrete, and descriptive geometry at leading university. B-3516.

CANDIDATE FOR PH.D. IN MECHANICS-AERODYNAMICS; Jun. Am. Soc. C.E.; Sigma Xi (Member); B.S. in C.E., cum laude, 1932; M.C.E., 1933. Graduate work in mechanics, aerodynamics, structures (emphasis on wind-stress analysis), physics. Able to read French and German. Summer experience in surveying and building construction. Well acquainted with wind-tunnel research. Available September 1935. D-3888.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 27; married; B.S. in C.E., 1929; M.S. in C.E., 1933; 1¼ years experience as structural detailer and in surveying, highway inspection, and lock construction; 5 years as instructor—structures and surveying—at state university, including 4 summers in survey camp. Graduate work, structures, highways, hydraulics, mechanics. Several publications. Desires position teaching structures, surveying, highways, hydraulics, and mechanics. C-6966.

STRUCTURAL ENGINEER; Assoc. M. Am. Soc. C.E.; graduate civil engineer, Polytechnic Institute of Zurich, Switzerland, 1919; majored in bridge engineering; married; citizen; 2 years teaching experience. In the United States since 1922 with foremost engineering concerns as design engineer. Expert on indeterminate structures. Desires to teach statics, graphic statics, statically indeterminate structures, concrete and steel bridges, rigid frames. B-5176.

RECENT BOOKS

New books of interest to Civil Engineers, donated by the publishers to the Engineering Societies Library, or to the Society's Reading Room, will be found listed here. A comprehensive statement regarding the service which the Library makes available to members is to be found on page 77 of the Year Book for 1935. These notes regarding the books are taken from the books themselves, and this Society is not responsible for them.

ARCHITECTS' SPECIFICATIONS—HOW TO WRITE THEM. By G. Goldsmith. New York, John Wiley & Sons, 1935. 131 pp., charts, 11 × 9 in., cloth, $2.50.

This is a comprehensive text on specification writing which will be of use to practising engineers and architects, as well as to students. The author discusses the various questions in logical sequence and in detail, giving wise practical advice on many points.

A.S.T.M. STANDARDS ON REFRACTORY MATERIALS, PREPARED BY COMMITTEE C-8 ON REFRACTORIES. February, 1935, Philadelphia, American Society for Testing Materials. 143 pp., illus., diagrs., charts, tables, 9 × 6 in., paper, $1.

This volume brings together in convenient form the publications of the society on the subject of refractory materials. The book contains the specifications for refractories, the standard methods of testing them, and the formulas for standard samples of refractory materials which the Society has approved. It also contains the manual for the interpretation of tests, the standard definitions, and surveys of the conditions under which refractories are used in open-hearth practice, in by-product coking, and in the malleable iron, copper, and lead industries.

MECHANICS OF MATERIALS. By S. G. George and E. W. Rettger. New York and London, McGraw-Hill Book Co., 1935. 483 pp., illus., diagrs., charts, tables, 9 × 6 in., cloth, $3.75.

A textbook covering the essential topics of a first course in this subject, intended for students of engineering in American universities. The treatment aims to be simple and complete, and numerous complete examples are introduced to illustrate the application of theory. In discussing the design of members, modern methods of analysis and treatment are used. A chapter is devoted to the slope-deflection and moment-area methods, and the theorem of three moments.

MILITARY ENGINEERING, Vol. 3, Pt. 1. BRIDGING (General Principles and Materials), 1934. Great Britain, War Office. London, His Majesty's Stationery Office, 1934. 284 pp., illus., diagrs., charts, tables, 9 × 6 in., cloth, 5s 6d.

This volume, prepared by the British War Office, describes the design and erection of road bridges, with special reference to the use of materials that can be obtained locally. The design and construction of timber, suspension and floating bridges are discussed, and there are chapters on the launching of steel bridges, pier construction, and pile driving. The necessary tables are included.

OUTLINE OF TOWN AND CITY PLANNING. By Thomas Adams. New York, Russell Sage Foundation, 1935. 368 pp., illus., diagrs., maps, charts, 9 × 6 in., cloth, $3.

This beautifully illustrated volume gives the historical background of city planning from ancient times to the present. Almost half the book is devoted to this survey of the development of planning; the rest of it presents a more detailed account of twentieth century progress in the art. Aims and methods in the United States are given special consideration.

PRACTICAL DESIGNING IN REINFORCED CONCRETE. Pt. 3. By M. T. Cantell. London, E. & F. N. Spon; New York, Engineers Book Shop, 1935. 221 pp., illus., diagrs., charts, tables, 9 × 6 in., leather, $5.

This is the concluding part of a three-volume text covering the design of most structures in which reinforced concrete is used. Advanced mathematics is avoided, and fully worked examples are used freely to illustrate the application of the methods. The third volume discusses the design of chimneys, bridges, arches, domes, beams, columns, and similar structures.

PRACTICAL SOLUTION OF TORSIONAL VIBRATION PROBLEMS. By W. K. Wilson. New York, John Wiley & Sons, 1935. 438 pp., illus., diagrs., charts, tables, 9 × 6 in., cloth, $7.

This book is intended to assist designers by presenting the principles and computation details of torsional vibration in a manner suitable for everyday reference. The material and arrangement are the results of several years of experience, and the methods presented have been tested in practice.

PRINCIPLES OF HIGHWAY ENGINEERING. By C. C. Wiley. 2 ed. New York and London, McGraw-Hill Book Co., 1935. 542 pp., illus., diagrs., charts, tables, 9 × 6 in., cloth, $4.

In the new edition this valuable textbook has been thoroughly revised and largely rewritten, to take cognizance of new developments in materials and methods. The original plan of treatment, which gave primary consideration to the objects to be attained and the effect of processes and variations on the results, has been retained.

PRINCIPLES OF PHASE DIAGRAMS. (Alloys of Iron Research, Monograph Series.) By J. S. Marsh, with a foreword by J. Johnston. Published for the Engineering Foundation by the McGraw-Hill Book Co., New York and London, 1935. 193 pp., diagrs., charts, tables, 9 × 6 in., cloth, $3.

Chemists and metallurgists will find in this book a clear, concise presentation of the principles of phase theory, designed especially to facilitate a clear understanding of ternary phase diagrams. The book is admirably planned to prepare the reader to interpret phase diagrams and to work out special cases. Users of the Alloys of Iron Research Monographs will find it very valuable as a key to the diagrams that those works contain.

REPORT ON SIGNIFICANCE OF TESTS OF CONCRETE AND CONCRETE AGGREGATES, sponsored by A.S.T.M. Committee C-9 on Concrete and Concrete Aggregates. Philadelphia, American Society for Testing Materials, 1935. 125 pp., charts, table, 9 × 6 in., paper, $1.25 ($1 to members).

This report of the Committee on Concrete and Concrete Aggregates of the American Society for Testing Materials discusses the various tests adopted by it. The limitations and applications of various methods of testing, their importance, and their interpretation are considered.

SEATTLE. GRADE SEPARATION COMMISSION REPORT ON SEPARATION OF GRADES IN SOUTH END INDUSTRIAL DISTRICT, May, 1930. 107 pp., diagrs., charts, maps, tables, 11 × 9 in., cardboard, apply.

The commission was appointed to study the permanent separation of street and railway grades in the industrial and railway district of Seattle, and to prepare advisory plans for its accomplishment. Three schemes were considered, and cost estimates were prepared. These are presented in detail, and recommendations are also given. Drawings of proposed viaducts, retaining walls, and similar features are included in the report.

TABLES AND OTHER DATA FOR ENGINEERS AND BUSINESS MEN, compiled by members of the College of Engineering of the University of Tennessee. Knoxville, University of Tennessee Cooperative Book Store. 139 pp., tables, 6 × 3 in., leather, 75 cents.

A convenient vest-pocket volume containing a selection of mathematical, mechanical, and electrical tables and formulas that are constantly used by engineers. The information has been compiled by members of the College of Engineering of the University of Tennessee.

THEY BUILT THE WEST. By Glenn Chesney Quiett. New York and London, D. Appleton-Century Company, Inc., 1934. 587 pp., illus., 9 × 6 in., $5.

This book gives a vivid picture of the remarkable expansion and development of our Western States, with chapters on the building of the important Pacific Coast cities from Portland to San Diego. The rise of the principal industries, the railroads, and the oil fields, and the reclamation of desert areas are clarified and enlivened by character sketches of the men who promoted and engineered these developments. The illustrations range from old engravings to photographs of the latest engineering projects.

TUNNELBAU. (Sammlung Göschen 1087.) By H. Wegele. Berlin and Leipzig, Walter de Gruyter & Co., 1935. 139 pp., diagrs., tables, 6 × 4 in., cloth, 1.62 rm.

A very condensed account of tunnel design and construction, accompanied by a bibliography of more than ordinary length. Tunnels under land and under water are considered.

TURBULENZ, PHYSIKALISCHE STATISTIK UND HYDRODYNAMIK. By H. Gebelein. Berlin, Julius Springer, 1935. 177 pp., diagrs., charts, 9 × 6 in., cloth, 14 rm.

This book is the result of an investigation of the problem of turbulence, undertaken in 1932 by the author under the direction of Professor Prandtl. The object was to develop or establish theoretical hydrodynamics to include the phenomena of turbulence, by applying the statistical method which has proved so helpful in other branches of physics. The author applies the method to the phenomena of flow and develops general basic statistical equations and a theory, which compare satisfactorily with experimental findings.

WOOD STRUCTURAL DESIGN DATA, Vol. 1. By R. G. Kimbell, A. T. Upson, and M. Ahern. Washington, D.C., National Lumber Manufacturers' Association, 1934. 294 pp., 8½ × 11 in., $1.

This volume is replete with information and tables dealing with structural design and the use of lumber. It treats in logical continuity the fundamentals with which the architect, engineer, and building designer must be acquainted in order to use wood structurally in a safe and economic manner. The manual is made up primarily of factual and mathematical data in a form that can be applied to any wood, but it makes no attempt to influence the choice of the kind of wood.